EVALUATION OF BENEFITS
OF
IRRIGATION

GANG CANAL
(Rajasthan)

RESEARCH PROGRAMMES COMMITTEE PLANNING COMMISSION
NEW DELHI

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PREFACE

THE study of the benefits of irrigation from Gang Canal presented in this Report is one of the five studies of major projects initiated by the Research Programmes Committee towards the end of 1958. The studies were undertaken at the instance of the Planning Commission and Shri C. M. Trivedi member, and Shri Tarlok Singh, Additional Secretary (now member) took very keen interest in them. Unlike the other four studies which were entrusted to the Universities, this study was undertaken directly by the Research Programmes Committee. The investigation was carried out in two stages, namely : (i) a Farm Business survey during the course of which data relating to the principal primary benefits of irrigation were collected and analysed and (ii) a survey of processing and other industries, trade and transport. The interim report on the Farm Business survey was completed in March 1960 and after it had been considered by the Committee of Direction was scrutinised further and revised. The chapters on agricultural labour, industry and trade were completed in September 1960 and incorporated into the report. The report was revised further during 1961—63 in the light of suggestions of the Committee of Direction.

The Gang canal is a typical irrigation project launched in conditions highly favourable to its success and with an assured prospect of solid benefits accruing from it. The present evaluation of its benefits undertaken more than thirty years after its construction shows broadly that the credit items in the balance-sheet of gains and losses are numerous, the debit items are relatively few and small and the net balance of benefits adds up to an impressive total. It is hardly necessary to amplify this statement here because the principal findings and conclusions have been set out in the concluding Chapter XI.

Broadly speaking, the report falls into three parts. The first part covering Chapters I to IV presents the economic background of the tract and sets out the design of the inquiry. The second part covering Chapters V to VIII is concerned with Farm Business survey and presents what are known as the direct or primary benefits of irrigation. The third part covering Chapters IX and X deals with the secondary benefits connected with the growth of industry and trade.

The findings and conclusions reached on the basis of the large volume of data collected, tabulated and sifted in an inquiry of this kind are necessarily subject to limitations. The period of the inquiry being limited, the data collected relate to only one year and, therefore, it is difficult to generalise in terms of a longer period. The data do not always lend themselves to general inferences because of the nature of 'control' units and the presence of certain social and psychological factors to which reference is made in the report.

Nevertheless the purpose of an inquiry of this kind being to probe into the data with a view to unravelling the truth, the attempt has been to derive, as far as possible, sufficient conclusions from the data.

A study of this kind involving extensive investigations and considerable analysis requires the cooperation and willing help of a large number of persons. The Research Programmes Committee was able to secure such cooperation not only from the State Government of Rajasthan and the District authorities but also from the very large number of cultivators, artisans, agricultural labourers, industrialists, traders and village functionaries who patiently answered the numerous questions put to them from an elaborate questionnaire. Supervisory and field staff specially recruited for carrying out this inquiry worked with earnestness and zeal, sometimes under trying field conditions.

The contribution of Shri Sanjeeva Rao, Senior Research Officer (now Assistant Chief) needs special mention as he was associated with this inquiry from the beginning and his assistance at all the stages of the enquiry was very valuable.

This study was financed by a grant from the Research Programmes Committee, but neither the Planning Commission nor the R.P.C. bears any responsibility for the facts and opinions expressed in the report.

D. K. Malhotra

Member Secretary

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CHAPTER I

THE GANG CANAL

Historical

1.0 The Gang canal named after his Highness, Maharaja Sir Ganga Singh of Bikaner to whose imagination the canal owes its origin, was taken up for construction towards the end of 1925 and formally opened by the then Viceroy at Shivpur on 26th October, 1927. It is said that soon after the Maharaja's assumption of power, the State had to face a severe famine in the year 1899 which took a heavy toll of life, both human and bovine. The tragedy left a deep impression on the mind of the young ruler who in an attempt to avert repetition of such a catastrophe ceaselessly strove to organise artificial means of irrigation. This effort bore fruit over a period of nearly three decades.

1.1 The idea of extending irrigation into the Bikaner State from the Sutlej river is also traced back to the year 1855 and is attributed to Colonel Dyas of the Royal Engineers. The first concrete proposal, however, was drawn up by the Punjab Government in 1905 when the Sutlej Valley Project was considered for harnessing the waters of the river below its confluence with the Beas river to irrigate areas in the British territory and the Bahawalpur State (now in Pakistan) as also the northern portions of the Bikaner State.

The Canal and Distributaries

2.0 The canal thus forms part of the Sutlej Valley Project and takes off at Hussainewala in Ferozepore District of the Punjab on the left bank of the river. In the first 74 miles of its length, the canal passes through the Ferozepore District and near its tail at Shivpur bifurcates into the two branches, the Feeder and the Laxmi Narainji. The Feeder flows southward along the eastern boundary irrigating almost entirely to the west. The Laxmi Narainji flows west to the Indo-Pakistan border where it divides into two distributaries. The alignment of the distributaries has been necessitated by the existence of a depression running centrally through the commanded area. These main branches in turn fall out into a number of distributaries and minor branches traversing the entire length and breadth of the colony. The total length of the channels including the main canals and branches is 858 miles. The perennial channels cover a length of 724 miles while the non-perennial channels including their minors run to a length of 134 miles. The perennial channels have in all 23 distributaries, 66 minors and 984 outlets including 9 mandi outlets and 3 garden outlets. Besides the main net-work of perennial channels there are two *kharif* or non-parennial channels, the Sameja and the Lalgarh. The total length of the non-perennial channels inclusive of minors is 131 miles. The Sameja restarted as a non-perennial channel in 1937 has one distributary with 5 minors and 79 outlets and has a culturable command of 40,625 acres mostly in the Raisinghnagar Tehsil. The Lalgarh non-perennial was opened in kharif 1938 and has a culturable command of 58,071 acres in Ganganagar and Padampur Tehsils. This canal has 9 distributaries and 3 minors with 98 outlets. The water supply in this channel is better than that of Sameja. The non-perennial channels run for about 3 months in a year, that is, in the kharif period when supplies from the river are normally in excess of the requirements of the perennial channels.

2.1 Of interest, however, is the fact that the main canal except for the first five miles at the head reaches, is a concrete lined channel of 52 ft. bed width. The canal thus is described as the largest lined canal in the world. The earlier portion is unlined mainly because of the high spring level in the area which would have endangered the canal. The lining of the canal was recommended in the 1920 project report largely with a view to improving the command and to set at rest the fears about the tract between the canal and the river getting even more waterlogged. The lining of the canal which cost about Rs. 82 lakhs not only cut the absorption losses but also helped to bring under irrigation an additional area of 44,500 acres shown as uncommanded area in the earlier project proposals. The decision of the then Bikaner Government to reduce the intensity of irrigation further facilitated an increase in perennial irrigation from the original figure of 5 lakh acres to 7.5 lakh acres of which 6.5 lakh acres were culturable. In the year 1935, the designed head of the canal was also increased from 2,144 to 2,720 cusecs consequent on the recommendations of the Indus Water Distribution Committee. This entailed raising the banks of the main canal as also its lining to ensure safe run of the increased supply.

Growth of Irrigation

3.0 The tripartite agreement of 1920 for sharing of the Sutlej waters between the States of Bhawalpur, Bikaner and British provided for a gross irrigation of 5 lakh acres under perennial canals. It was assumed that the rabi irrigation would be 1½ times that of kharif and an annual intensity of about 63 per cent was provided in the 1921 project. In terms of the culturable command of 6,50,588 acres, the percentage intensity was reckoned at 53 per cent. The irrigation forecast on the basis of the then available water supplies was about 3.4 lakh acres or 1.4 lakh acres under kharif and 2 lakh acres under rabi. The project proposals visualised that irrigation in the Gang canal would eventually attain the same efficiency as in the Punjab canal colonies and that efficiency in the non-perennial channels as well would eventually increase. When the water supply position was acute during the kharif period, preference would be given to the perennial channels, as evidently it would not be possible to meet the minimum requirements of all the canals. The water supply position during the two principal seasons was examined in the Project Completion Report and it was stated that while there would be occasional difficulty for rabi irrigation and normally the supply would be good. the kharif supplies would be perpetually deficient except during the months of September and October.

3.1 The development of irrigation under the Gang canal has been remarkably rapid. Figures in Table No. 1.0 show that irrigation has been increasing by about 9 per cent annually. It is also noteworthy that within three decades of the commencement of operation of the canal, irrigation has more than trebled. In particular, during the last decade, the development has been strikingly rapid with an increase of over 36 per cent.

3.2 Figures in Table No. 1.1 showing quinquennial averages further indicate that the extension of irrigation under non-perennial channels has also been marked. Indeed both in absolute acreage and in relation to total irrigation, growth of non-perennial irrigation is a significant achievement. Non-perennial irrigation first started in kharif 1937 under the Sameja, was about 7 per cent of the total acreage during the first five years. It has since increased to the present figure of about 13 per cent. These figures reflect the improved position of water supply in these canals and the ever increasing demand for this vital service in this region. The break-up of area under the principal crops indicated in Table No. 1.2 further suggests that the percentage area under kharif has increased markedly thus belying the original fears of limited and uncertain irrigation in this season expressed in the Project Report.

3.3 The culturable command of the canal has increased from an average of 6.6 lakhs acres during the first five years of operation of the canal to 7.54 lakhs acres in the last quinquennium (Table No. 1.3). In the year of reference, the culturable commanded area was 7.58 lakhs acres. A comparison of figures of culturable commanded area and actual irrigation show that irrigation intensity has increased over the years to a level of over 80 per cent in the last quinquennium. In 1958-59, it was even higher at 95 per cent. In the very early stages of development, irrigation had exceeded the permissible limit of 60 per cent (24 per cent in kharif and 36 per cent in rabi) envisaged in the project. The present intensities in kharif and rabi are 46 per cent and 56 per cent indicating respectively an increase of nearly 92 per cent and 50 per cent over designed limits. The increase under kharif irrigation has been particularly marked especially considering that no permissible limits were specified for the non-perennial channels.

TABLE No. 1.0

Growth of Irrigation under Gang Canal

Year	Area irrigated (acres)	Percentage variation (Annual)
1	2	3
1928-29	1,93,040	
1929-30	3,30,846	71·4
1930-31	3,51,237	6·2

1	2	3
1931-32	3,09,389	—11·9
1932-33	3,09,365	—0·007
1933-34	3,77,409	21·9
1934-35	3,45,107	—8·6
1935-36	3,79,229	9·9
1936-37	4,02,908	6·2
1937-38	4,47,268	11·0
1938-39	4,56,646	2·0
1939-40	4,77,794	4·6
1940-41	5,04,198	5·5
1941-42	4,61,915	—8·4
1942-43	5,18,742	12·3
1943-44	5,32,897	2·7
1944-45	5,24,145	—1·6
1945-46	5,56,924	6·3
1946-47	5,51,429	—1·0
1947-48	4,71,705	—14·5
1948-49	5,49,007	16·4
1949-50	5,80,168	5·7
1950-51	6,03,609	4·0
1951-52	6,14,717	1·8
1952-53	6,35,253	3·3
1953-54	6,30,946	—0·7
1954-55	6,55,628	3·9
1955-56	6,50,412	—0·8
1956-57	6,91,547	6·3
1957-58	7,20,445	4·2
1958-59	7,23,698	0·5
Percentage increase (1928-29 to 1958-59)		274·9

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TABLE No. 1.1

Growth of Irrigation under perennial and non-perennial channels
(quinquennial averages)

Quinquennial periods	Perennial		Non-Perennial		Total	
	Area (acres)	Per cent increase	Area (acres)	Per cent increase	Area (acres)	Per cent increase
1	2	3	4	5	6	7
1928-29 to 1932-33	2,98,767 (100·0)	—	—	—	2,98,767 (100·0)	—
1933-34 to 1937-38 ..	3,90,384 (100·0)	30·6	—	—	3,90,384 (100·0)	30·6
1938-39 to 1942-43 ..	4,51,049 (93·2)	15·5	32,810 (6·8)	—	4,83,859 (100·0)	21·4
1943-44 to 1947-48 ..	4,74,344 (89·9)	5·2	53,076 (10·1)	61·8	5,27,420 (100·0)	9·0
1948-49 to 1952-53 ..	5,29,133 (88·6)	11·6	67,418 (11·4)	27·0	5,96,551 (100·0)	11·2
1953-54 to 1957-58 ..	5,84,165 (87·2)	10·4	85,631 (12·8)	27·0	6,69,796 (100·0)	12·3

NOTE.—Figures in brackets in cols. 2 & 4 represent percentages to total irrigated area in col. 6.

TABLE NO. 1.2

Growth of irrigated area under Kharif and Rabi

Years	Kharif		Rabi		Total	
	Area (acres)	Per cent increase	Area (acres)	Per cent increase	Area (acres)	Per cent increase
1	2	3	4	5	6	7
1928-29 to 1932-33 ..	1,14,617 (38·3)	—	1,84,159 (61·7)	—	2,98,776 (100·0)	—
1933-34 to 1937-38 ..	1,68,496 (43·2)	47·0	2,21,888 (56·8)	20·5	3,90,384 (100.0)	30·7
1938-39 to 1942-43 ..	2,20,319 (45·5)	30·8	2,63,480 (54·5)	18·7	4,83,799 (100·0)	23·9
1943-44 to 1947-48 ..	2,31,088 (43·8)	4·9	2,96,332 (56·2)	12·4	5,27,420 (100·0)	9·0
1948-49 to 1952-53 ..	2,54,628 (42·7)	10·1	3,41,923 (57·3)	15·4	5,96,551 (100·0)	13·1
1953-54 to 1957-58 ..	2,91,723 (43·5)	14·6	3,78,073 (56·5)	10·6	6,69,796 (100·0)	12·3

NOTE.—Figures in brackets in cols. (2) and (4) represent percentages to total Irrigated area in col. (6).

TABLE NO. 1.3

Area irrigated and percentage intensity

(in acres)

Years	C.C.A	Irrigated area	Percentage Intensity
1928-29 to 1932-33	6,63,237	2,98,776	45·0
1933-34 to 1937-38	6,52,632	3,90,384	59·8
1938-39 to 1942-43	6,48,527	4,83,799	74·5
1943-44 to 1947-48	7,41,974	5,27,420	71·1
1948-49 to 1952-53	7,41,974	5,96,551	80·4
1953-54 to 1957-58	7,54,427	6,69,796	80·8

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3.4 Efficiency of irrigation is usually measured by the extent of 'duty' a term which expresses the area irrigated by one unit (cusec) of discharge. The Ganga canal was designed for a duty of 234 acres at the outlet. During the period 1928-29 to 1935-46, the duty on mean discharge varied from 167 acres to 247 in the rabi and 103 and 141 in kharif*. It was also stated in the Settlement Report that the average duty for the years 1940-41 to 1944-45 was 383 acres which represents 64 per cent increase on the designed capacity. The increase in irrigation was mainly facilitated by increased share of canal supplies consequent on the recommendations of the Indus Water Distribution Committee, improvements in distribution and economy in the use of water by the cultivators. More recent data for the year 1958-59 also suggests increase in the duty figures.

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*Irrigation Administration Reports.

Cost

4.0 The total capital outlay on the main canal and the branches including the share of the headworks amounted to Rs. 3.23 crores at the end of 1953-54(1). The cost as originally provided in the 1921 Project was Rs. 2.01 crores and was raised subsequently in 1924 to Rs. 2.42 crores and to Rs. 2.74 crores in 1926, that is, an overall increase of 36 per cent. The sanctioned estimate for the main canal based on the 1926 Project was Rs. 1,62,97,859. The actual cost as given in the Completion Report, however, was Rs. 1,53,57,980, thus resulting in a saving of Rs. 9,39,879.(2) Together for the main canal and distributaries as also the share of head works, the savings in cost as compared to the 1926 Project was Rs. 8,16,539 as will be seen from the following table.

TABLE NO. 1.4

Comparison of actual and estimated cost of canal

Works	Original Rs.	Actual Rs.	Difference Rs.
Main canal	1,62,97,859	1,53,57,980	(+)9,39,879
Branches and distributaries	59,79,441	63,90,514	(—)4,11,073
Share of head works etc. ..	52,50,044	49,62,311	(+)2,87,733
Total	2,75,27,344	2,67,10,805	8,16,539

Financial returns

5.0 The rapid development of irrigation under Gang canal has placed this project in a financially favourable position. Direct receipts from water rates have increased from Rs. 17.5 lakhs in the year 1929-30 to Rs. 38.8 lakhs in 1958-59 that is, in percentage terms an increase of 122. The financial results of the project are given in Table No. 1.5. Considering quinquennial average receipts it is seen that revenues on this project have increased by 182 per cent in the quinquennium ending 1956-57. Since then the receipts have increased even further. The most conspicuous increase is observed in the immediate post-Independence period. This was in the main due to large influx and settlement of displaced persons in the colony.

5.1 It will also be observed that increase in net receipts over the years has been even more than indicated by figures of gross receipts. In other words, net revenues have increased by 362 per cent in the quinquennium ending 1956-67. This has been made possible by the relatively lower operational charges on the canal. For instance, in relation to gross receipts the working expenses have actually declined in recent years improving thereby net revenues in this project. The average net receipts for the years 1957-59 amounted to Rs. 28-25 lakhs. On an investment of Rs. 3.23 crores this

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1 Irrigation in India-Review and Financial results, CWPC, Ministry of Irrigation, 1953-54.

2 Completion Report of Sutlej Valley Project, 1935.

works out to a return of 8.7 per cent which is higher than the prescribed productivity return of 6 per cent. It will, however, be noted that no allowance has been made for interest charges for which data are not readily available. The more advantageous position in regard to percentage return on this canal would be maintained if receipts were compared to later figures of sum-at-charge.

TABLE NO. 1.5

Grass Receipts, working expenses and net receipts

Year	Gross Receipts (Rs.)	Percentage increase (cumulative)	Working Expenses (Rs.)	Net Receipts Col. 2—4) (Rs.)	Percentage increase (cumulative)
1	2	3	4	5	6
1927-28 to 1931-32	11,12,713	—	6,26,663 (56·32)	4,86,050	—
1932-33 to 1936-37	17,49,621	57·24	3,78,189 (21·62)	13,71,432	182·2
1937-38 to 1941-42	21,92,648	97·05	5,79,583 (26·43)	16,13,065	231·9
1942-43 to 1946-47	21,65,722	94·63	8,29,886 (38·32)	13,35,836	174·8
1947-48 to 1951-52	61,45,304	452·28	36,51,410 (59·42)	24,93,894	413·1
1952-53 to 1956-57	31,33,402	181·60	8,88,923 (28·37)	22,44,479	361·8

NOTE.—Figures in brackets in col. (4) indicate percentage to gross receipts in Col. (2).

The Colony

6.0 The rapid development of irrigation has largely been facilitated by the colonisation operations which commenced prior to the canal. At that time, the population was sparse and ownership rights in land varied from full legal rights to the nebulous claims of the squatter. It was aptly remarked that the general aspect of Bikaner was "dreary and desolate in the extreme". Lord Elphinston the then Governor-General who passed through the territory on his way to Kabul said to have observed that within a short distance of the capital the country was as waste as the wildest parts of Arabia.

6.1 The carving of the colony commenced after detailed rectangulation survey of the tract was completed. The entire area was then divided into squares of 25 bighas each (or 15.5/8 acres) the length of each side of a square being 825 ft. After laying the squares new *chaks* were formed with an area of about 50 squares or approximately 780 acres each which were named after the water courses designed to serve them. The lands of the old inhabitants whose varying rights were respected were consolidated and placed at separate water courses according to communities and religion to minimise friction and feud. They were as far as possible allotted land from their former holdings. Where the old settlers or 'abādkars' could not be located in these *chaks*, mixed *chaks* were created where a certain proportion of the land was held by the old 'abadkars' and the remaining by the State. The remaining area was sold to new settlers mostly from the Punjab who were settled in the villages on the same general principle as in the case of old villages. The irrigable land was sold out at prices fixed for the purpose and from each about 25 per cent was charged as earnest money at the time of the sale and the balance recovered in annual instalments. Even before the canal came into operation, much of the land had already been allotted. At present, there are 1122 *chaks* in all (949 under Perennial and 173 under non-perennial) in the Gang Canal colony as against the original number of 1046 *chaks*, the increase being largely due to the increase in the number of outlets.

CHAPTER II

THE GANGANAGAR DISTRICT

1.0 THE DISTRICT of Ganganagar at the north-western extremity of Rajasthan forms part of the vast Indo-gangetic valley. Bounded by Pakistan on the north and west, Ferozepur district in the Punjab on the east and the districts of Bikaner and Churu of Rajasthan on the south, Ganganagar stretches over an area of 8,225 square miles. The total land surface of the district according to the village papers is 15 lakh acres. Nearly 64 per cent of this area represents cultivated land, a greater part of which is located in the colony. The remaining area in the main represents culturable wastes and provides an index of potential for extensive cultivation in this district. There are no forests of any description in this area, the soils of which are eminently suited to cultivation but for lack of assured water supply.

Population features

2.0 The District is divided into 5 revenue sub-divisions and 9 tehsils with a total population of 6.3 lakh persons according to the census of 1951 (Table No. 2.0.). The tehsils of Ganganagar, Padampur, Raisinghnagar, Karanpur and Anupgarh are served by the Gang canal and its distributary network. The first four of these were carved out from the old Mirzawala tehsil at the time of the opening of the colony. Except in the Ganganagar tehsil where irrigation is extensive, patches of uncommanded land occur in each of the tehsils of the colony.

TABLE No. 2.0

Area, population and density (Tehsil-wise) of Ganganagar District

Name of Tehsil	Area in sq. miles	Total population	Density
Ganganagar	539	132,567	246·0
Karanpur	317	68,635	216·5
Padampur	324	58,629	180·9
Raisinghnagar	510	43,574	85·4
Anupgarh	832	27,673	33·3
Colony (Sub-Total)	2,522	331,078	131·3
Hanumangarh	1,147	1,04,406	91·0
Surat garh	788	44,797	56·9
Nohar	231	83,562	361·7
Bhadra	470	66,287	141·0
Other Tehsils (Sub-Total)	2,636	2,99,052	113·4
District	5,158	6,30,130	122·2

NOTE.—The area of Ganganagar District, as given by the Surveyer General's Office is 8,225 sq. miles. The Tehsil break-up is not available. In terms of above area the average density is 77 persons per sq. mile.

सत्यमेव जयते

2.1 A significant feature of the district is its very low density of population of about 77 persons per square mile as compared to the average of 177 for the State of Rajasthan. Over the greater area of the district the villages are extremely small and have a population of less than 500 persons. Although the District ranks fifth in Rajasthan in terms of area, its position is considerably lower down in terms of concentration of population. The figures of population in Table No. 2.0 above show the concentration of population in the colony areas. Population in this district has increased by about 340 per cent over the last 50 years (Table No. 2.1). It is also significant that the rise has been greater during the period 1921—51 which corresponds to the opening and development of the colony. During this period, the annual average rise has been 9 per cent as compared to about 2 per cent in the earlier decades.

TABLE NO. 2·1

Growth of population in Ganganagar District

Census years	Total population	Variation	Percentage variation
1	2	3	4
1901	1,43,422	—	—
1911	2,06,068	+62,646	+43·7
1921	1,70,593	(—)35,475	(—)17·2
1931	3,45,436	+1,74,843	+102·5
1941	5,33,974	+1,88,538	+54·7
1951	6,30,130	+96,156	+18·0
TOTAL		+4,86,708	+339·4

सत्यमेव जयते

2.2 A comparison of the figures of population tehsil-wise brings out this feature even more clearly. As would be seen from Table No. 2.2 during the 20 years beginning 1931, the colony population has risen by about 128 per cent while in the rest of the district, the rise is only 50 per cent. The increase is the largest in the Padampur. followed by Raisinghnagar while it is the lowest in Anupgarh. In the uncommanded area the growth of population has been the largest in Hanumangarh area where it is 60 per cent. During the two decades the average annual rise was 6 per cent in the colony as against 2½ per cent in the rest of the district. The average annual growth for the district works out to 4 per cent.

TABLE NO. 2·2

Growth of population in colony and other Tehsils of Ganganagar District

Tehsil	1951	1941	1931	Percentage increase
1	2	3	4	5
Ganganagar	1,32.567	1,03,109	62,448	112
Karanpur	68,635	59,408	30,525	125
Padampur	58,629	38,017	18,832	211
Raisinghnagar	43,574	55,523	14,571	199
Anupgarh	27,678	27,347	18,883	47
Colony	3,31,078	2,63,404	1,45,259	128
Hanumangarh	1,04,406	1,01,347	65,272	60
Suratgarh	44,797	37,630	32,952	36
Nohar	83,562	75,031	56,664	18
Bhadra	66,287	56,562	45,289	24
Other Tehsils	2,99,052	2,70,570	2,00,177	49
District	6,30,130	5,33,974	345,436	82

2.3 Colonisation seems to have followed mainly the type of land obtaining in the tract. For instance the Ganganagar and Karanpur areas which have relatively better class of land came to be colonised first and only slowly in later years people moved southwards. Partly it might also be due to better water supply position in the former areas. Towards the tail-end of the canal in the Raisinghnagar and Anupgarh areas even today land is relatively more and population sparse. There is greater uncultivated area here and land is poor in productive characteristics.

2.4 The principal source of livelihood in the District is agriculture which provides employment to over 81 per cent of the population. Among the non-agricultural occupations the most important are the services and professions which account for 9 per cent while industry, trade and transport provide employment to respectively 3.7 per cent, 5.7 per cent and 0.5 per cent of the total population.

Rainfall

3.0 The district is situated in the extreme dry belt of the State. Characterised by exceptionally warm summers, it is subject to frequent sand-storms of varying intensity in the summer months, even if storms of a high velocity are less frequent. Humidity is said to have risen on account of canal irrigation and the intensity of sand-storms is said to be generally lower in the colony as compared with the uncommanded area. The district as a whole, however, receives meagre rainfall, located as it is at the end of the monsoon range. The average rainfall varies between 7″ to 20″ in the colony while in the rest of the district it ranges between 11″ to 16″ as would be seen from Table No. 2.3 showing the rainfall figures during the last 5 years. The quinquennial average is 13″ in the uncommanded area outside the colony while in the canal colony it is 11″ suggesting the somewhat more favourable distribution in the uncommanded area. Within the colony again, both the total and average rainfall is less in Anupgarh area in comparison to other tehsils. This is followed by Rainsinghnagar which is close to Anupgarh. Outside the commanded zone, Suratgarh tehsil has recorded the least average rianfall of 7.8″ which is comparable to that of Anupgarh in the colony and is otherwise considerably less than the district average.

3.1 Figures of seasonal distribution of rainfall in particular during the monsoon months from June to September would suggest the more favourable position of the uncommanded area as compared to the colony (Table No. 2.4.). The average monsoon supplies in the colony as a whole vary from 3″ to about 18″ as against 6″ to 15″ in the other areas. The average for this period is thus 9″ for the colony and 10″ for the areas outside the colony. About 80 per cent of the total rainfall for the 5 years has been recorded in this period. The winter supplies on the other hand, (that is for the period between December to March) are slightly more favourable for the colony. The winter rains which affect the prospects of Rabi crops are seen to be more evenly distributed between different areas both in the colony and in other areas of the district. The minimum and maximum fall ranges between 0.9″ to 2.6″ in the colony while the corresponding variation in the other areas is 0.5″ to 2.1″. The five year average of winter rains works out to 1.7″ in the colony as against 1.4″ in the rest of the district. In the summer and autumn months, however, the quantum of rainfall is insignificant and does not normally exceed 1″.

3.2 What is significant in these figures is the feature that not only sharp variations occur in precipitation between various years but that, not unoften, in the same year differences between different areas are quite marked. Considering the colony, the Padampur area has received the largest amount of precipitation during the period 1954—58, raising its average to 13″ as against Anupgarh which has an average of only 8″ for the period. The variations between the tehsils in terms of average annual rainfall for the last 5 years are not very different from those obtaining in the uncommanded areas of the district.

3.3 The figures in the table would also suggest the exceptional character of the year 1958 when the district as a whole received about 18″ of rainfall. From the figures of rainfall for the years 1928-29 to 1944-45 given in the Settlement Report, it would appear that the year 1937-38 was the worst when the colony average was about 3″ only(¹). The average figures for the last 5 years for the colony, however, are considerably higher. Corresponding data are not available for other areas and years to enable any meaningful generalisations to be made nor are the present data adequate or suggestive

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1 Assessment report of first regular settlement of Gang Canal, 1946, pp. 5·5.

TABLE NO. 2·3

Annual Rainfall (Tehsil-wise) in Ganganagar District

Year	Ganga-nagar	Karan-pur	Padam-pur	Raisingh-nagar	Anup-garh	Colony (average)	Hanuman-garh	Surat-garh	Nohar	Bhadra	Uncomm-anded (Average)	District (Average)
1	2	3	4	5	6	7	8	9	10	11	12	13
1954 ..	9·25	10·51	10·75	4·65	2·65	7·56	9·73	6·51	15·73	15·63	11·90	9·49
1955 ..	6·61	8·99	7·20	4·95	10·47	7·64	9·96	5·72	17·84	16·11	12·41	9·76
1956 ..	16·25	17·84	12·69	12·99	13·44	14·64	15·41	9·24	16·50	16·58	14·43	14·55
1957 ..	6·69	10·15	3·63	10·04	3·79	6·86	9·76	6·98	14·49	11·12	10·59	8·52
1958 ..	20·07	19·51	32·00	17·87	9·75	19·84	13·62	10·43	23·42	15·25	15·68	17·99
1954—58 ..	11·77	13·40	13·25	10·10	8·02	11·31	11·70	7·78	17·60	14·94	13·00	12·06

TABLE NO. 2.4

Average Rainfall

(in inches)

Period	1954		1955		1956		1957		1958		1954—58	
	Colony	Rest of Dist.	Colony	Rest of Dist.	Colony	Rest of Dist.	Colony	Rest of Dist.	Colony	Rest of Dist.	Colony	Rest of Dist.
1	2	3	4	5	6	7	8	9	10	11	12	13
I. Dec. to March	·9	2·4	1·6	0·5	1·4	1·1	2·6	2·1	2·2	0·9	1·7	1·4
II. April to May ..	—	0·1	1·0	0·5	—	—	1·0	0·4	0·2	—	0·4	0·2
II. June to September ..	6·7	9·4	5·0	5·6	12·3	12·1	3·2	8·0	17·5	14·7	9·0	10·0
V. October to November	—	—	—	5·8	0·9	1·2	0·1	0·1	—	0·1	0·2	1·4
TOTAL	7·6	11·9	7·6	12·4	14·6	14·4	6·9	10·6	19·9	15·7	11·3	13·0

of any secular trends in rainfall pattern. The extreme degree of aridity of the region indicated by these figures, however, can hardly escape notice.

Topography and soils

4.0 Except for the canal colony which is at an average elevation of 550 ft. above the sea level, the district is a high and flat country interspersed by sand dunes. The tract could scarcely be described as hilly and there are no natural drainage channels or streams except the Ghaggar *Nali* which flows through the depression of the old bed of Ghaggar river now extinct. During heavy rains, however, excess water is borne down to the bed of the river inundating at times part of Sadulgarh. In the canal colony, however, the deficiency of natural streams is more than made up by the wide network of irrigation channels.

4.1 The geology of the district, in particular, the area under the command of the Gang canal is described as of recent origin, chiefly alluvial and fluvial origin. No detailed soil surveys appear to have been made in this region nor are any soil ratings specified or maintained in the revenue records. The recognised distinction in respect of cultivated area as 'Nehri' or irrigated and 'Barani' or unirrigated land is based mainly, as the name would suggest, on the measure of irrigation available rather than the physical property of soils. The soil is mostly alluvial derived mainly from the Himalayas. The First Settlement Report of the colony speaks of the tract under the command of the canal as one that presents a monotonous uniformity to the eye. It is natural, therefore, that a fairly uniform soil-crop complex is observed in this area. Certain differences, however, are discernible in the tract from the light loam in Ganganagar and Padampur areas through drift sands observed mainly in Raisinghnagar tehsil to the hard and clayey soils of Ghaggar bed in Anupgarh tehsil, the last being particularly suited to paddy cultivation. Injurious salt formations also occur in large patches particularly in the Anupgarh tehsil. These have reduced the land to a sterile condition known locally as 'kallar'. The entire canal colony slopes southwards from the north.

Communication facilities

5.0 Communications are fairly well developed in the district. There is a network of railway lines connecting the various towns in the district which provide the much needed means for the movement of agricultural surpluses of the area. An extension of the former Bikaner State Railway was opened at the time of construction of the canal. This canal loop starting from Hanumangarh junction passes through the heart of the colony linking up the important market towns of Ganganagar, Karanpur and Raisinghnagar and terminates at Suratgarh. A small branch also goes up to Anupgarh along the Ghaggar bed serving the adjacent irrigated areas. The total length of the canal railway is 163 miles.

5.1 Besides railways, roadways also provide quick transport facilities, mainly for the transport of passengers from and to the various towns and mandis. According to the basic statistics of Rajasthan(2) the road mileage in

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2 Basic Statistics—Rajasthan (1959) Directorate of Economics and Statistics.

Ganganagar district is 181 of which among others 112 miles are metalled and 46 miles are fair weather dressed-up tracts. The latter is typical of the communication facilities available in the non-colony area.

5.2 The district is well served with postal and telegraphic facilities. In 1958, there were 168 postal and telegraphic centres and offices in the district. Besides the general postal and telegraphic network, the canal department maintains its own telegraph service which facilitates quick communication of observations regarding canal discharges and levels.

Markets

6.0 The district, particularly the colony, is well served with markets and because of this the practice of selling surplus produce to the local money lender has now virtually disappeared. All the tehsil towns in the colony along with a few others are 'mandis' which draw extensive trade from neighbouring villages and tehsils. The Ganganagar mandi, however, is the most important and attracts produce not only from the colony but also from the rest of the district as well as the neighbouring States. It is also an important distribution centre. A sizeable quantity of farm products are exported annually from the district, the principal items being wheat, gram, barley, cotton and cottonseeds and rice. Oilseeds particularly, mustard, is again an important exportable commodity. In recent years, significant changes have taken place both in the extent and direction of trade.

6.1 A number of processing industries are located in the various towns, cotton ginning and pressing being the most important. There were about 51 registered factories in the district in 1957.

Crops

7.0 From the crop statistics of the district, it is observed that the principal crops here in the order of area covered are gram, bajra, wheat and barley. These are followed by mustard in the rabi and cotton in kharif seasons. In the canal colony, however, cotton followed by jowar, bajra and other fodder crops are principal kharif crops while wheat, gram and mixtures of these, cover the greater part of the area in rabi. Although proportionately small, rice covers an extensive area in the Anupgarh tehsil where it is a principal kharif crop. Sugarcane is also an important irrigated crop. It is, however, noteworthy that the area under sugarcane has somewhat declined in recent years while that under cotton has increased. The area under wheat has also steadily increased since 1950. In the uncommanded area bajra, jowar, gowar and moth are the main kharif crops while wheat and to a lesser extent, gram are the important rabi crops. Scarcity of pastures in the colony area and profusion of wastes in the uncommanded villages are other notable features.

Farm implements

8.0 Tables No. 2.5 and 2.5-A, show tehsilwise distribution of agricultural implements and machinery items for the year 1958 and the percentage

TABLE NO. 2·5

Number and distribution of major agricultural implements and machinery in the District of Ganganagar(year 1958)

Tehsils	Ploughs		Bullock carts	Sugar-cane Crushers	Oil Crushers	Tractors	Others	Total
	Wooden	Iron						
1	2	3	4	5	6	7	8	9
Colony								
Ganganagar	24,558	7,309	5,815	738	12	309	17	38,758
Padampur	11,791	4,060	1,901	1,125	7	116	4	19,004
Karanpur	11,482	4,822	2,523	830	47	208	5	519,917.
Raisinghnagar	15,792	3,654	1,559	677	6	123	—	21,811
Anupgarh	6,462	1,595	1,216	669	7	64	—	10,013
TOTAL	70,085	21,440	13,014	4,039	79	820	26	1,09,503
Other Tehsils								
Hanumangarh	26,247	7,483	2,132	11	6	252	10	36,141
Suratgarh	14,989	2,582	195	—	13	58	1	17,838
Nohar	18,303	125	109	1	9	33	9	18,589
Bhadra	18,672	58	105	—	7	20	7	18,869
TOTAL	78,211	10,248	2,541	12	35	363	27	91,437
DISTRICT	1,48,296	31,688	15,555	4,051	114	1,183	53	2,00,940

TABLE NO 2·5-A

Percentage distribution of major implements and machinery in the District of Ganganagar (Year 1958)

Tehsils	Ploughs		Bullock carts	Sugar cane Crushers	Oils Crushers	Tractors	Others	Total
	Wooden	Iron						
1	2	3	4	5	6	7	8	9
Colony								
Ganganagar	16·6	23·1	35·1	18·0	10·5	25·9	32·9	19·2
Padampur ..	8·0	12·8	11·5	28·4	6·1	9·7	7·5	9·4
Karanpur ..	17·7	15·2	21·3	20·4	41·2	17·4	9·4	10·4
Raisinghnagar	10·6	11·5	9·0	16·4	5·3	10·3	—	10·8
Anupgarh ..	4·4	5·0	7·3	16·4	6·1	5·4	—	5·0
TOTAL ..	47·3	67·6	84·7	99·7	69·2	68·7	49·0	54·8
Other Tehsils								
Hanumangarh	17·7	23·6	12·9	0·3	5·3	22·0	18·9	17·9
Suratgarh ..	10·1	8·2	1·2	—	11·4	4·9	1·9	8·8
Nohar ..	12·3	0·4	0·6	—	8·0	2·7	17·0	9·2
Bhadra ..	12·6	0·2	0·6	—	6·1	1·7	13·2	9·3
TOTAL ..	52·7	32·4	15·3	0·3	30·8	31·3	51·0	45·2
DISTRICT	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0

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TABLE NO. 2·6

Livestock (Tehsil-wise) in Ganganagar District (Year 1956)

Tehsil	Cattle	Buffaloes	Camels	Sheep Goats	Others	Total
1	2	3	4	5	6	7
Colony						
Ganganagar	7,843 (15·2)	26,649 (21·8)	7,927 (10·6)	40,513 (8·1)	2,314 (21·5)	1,25,246 (12·2)
Karanpur	32,355 (10·3)	18,971 (15·5)	3,474 (4·7)	28,409 (5·7)	1,258 (11·7)	84,467 (8·3)
Padampur	27,286 (8·7)	15,408 (12·6)	5,765 (7·7)	19,484 (3·9)	712 (6·6)	68,655 (6·7)
Raisinghnagar	26,431 (8·4)	12,997 (10·7)	5,428 (7·3)	26,145 (5·2)	698 (6·5)	71,699 (7·0)
Anupgarh	27,484 (8·7)	8,175 (6·7)	1,838 (2·5)	64,772 (12·9)	512 (4·8)	1,02,791 (10·0)
TOTAL	1,61,409 (51·3)	82,200 (67·3)	24,432 (32·8)	1,79,323 (35·8)	5,494 (51·1)	4,52,858 (44·2)
Other Tehsils						
Hanumangarh	43,990 (14·0)	16,043 (13·1)	1,575 (21·1)	66,761 (13·3)	2,191 (20·4)	1,44,742 (14·2)
Suratgarh	27,222 (8·7)	3,968 (3·2)	7,497 (10·1)	70,674 (14·1)	822 (7·6)	1,10,183 (10·8)
Nohar	55,363 (17·6)	9,840 (8·2)	16,028 (21·5)	1,41,685 (28·2)	1,575 (14·6)	2,24,491 (21·9)
Bhadra	26,395 (8·4)	9,962 (8·2)	10,804 (14·5)	43,116 (8·6)	677 (6·3)	90,954 (8·9)
TOTAL	1,52,970 (48·7)	39,813 (32·7)	50,086 (67·2)	3,22,236 (64·2)	5,265 (48·9)	5,70,370 (55·9)
DISTRICT	3,14,379 (100·0)	1,22,013 (100·0)	74,518 (100·0)	5,01,559 (100·0)	10,759 (100·0)	10,23,228 (100·0)

Note:—Figure in brackets are percentage to District Tota to the total stock in the district. The greater proportion of major implements and machinery items in the colony is an index of the adoption of improved cultivation practices. Outside the colony traditional implements are still in extensive use. Over two-thirds of a fairly common implement like iron plough is in use in the colony tehsils. An even larger proportion of bullock carts (85 per cent), tractors and oil crushers (69 per cent) and other items of fodder cutters etc. are also used in the colony. It is significant that the proportion of such implements decreases as we move from Ganganagar and Karanpur areas of intensive irrigation towards Raisinghnagar and Anupnagar tehsils where the proportion of uncommanded area is relatively large.

Livestock

9.0 From the figures in Table No. 2.6, it would appear that the number of animals is larger outside the colony area. In terms of absolute number of animals per village which is inclusive of both farm and non-farm categories of animals this is true but the composition of animal population differs considerably as between the two zones. Bullocks provide the main draught power in the colony (77 per cent) while outside the colony, camels are the most significant in number (67 per cent of the total). There are differences in respect of milch animals also. For instance, cows are the main milch cattle in the non-colony area with over 60 per cent of the total stock, while in the colony, she-buffaloes are greater in number being 65 per cent. As between various tehsils, it appears that both in terms of draught and milch animals, Ganganagar and Karanpur sub-divisions in the colony are better placed while in the non-colony area, Hanumangarh has the largest number of these animals.

9.1 The disparity between the colony and non-colony areas in respect of the distribution of animal wealth may further be seen in Table No. 2.7 which gives the average figures of livestock under the principal categories. It would be observed that the number of bullocks in the irrigated *chaks* is double that in the barani villages; on the other hand, camels in a barani village are 3 times as large as in an irrigated *chak*. Camels are not only the principal draught animals but more significantly provide the chief means of transport as well. On the whole, the number of draught and milch animals irrespective of the category, are greater in number in the uncommanded villages indicating the general importance of livestock economy in these areas where agriculture is still a gamble in rains.

TABLE NO. 2·7

Livestock under principal categories

Area	Draught cattle		Total	Milch cattle		Total
	Bulls	Camels		Cows	She-buffaloes	
1	2	3	4	5	6	7
Colony ..	72	29	101	56	48	104
Non-colony ..	35	97	132	137	41	178
District ..	58	55	113	87	45	132

Land Revenue

10.0 The total land revenue for the district amounted to Rs. 64.5 lakhs in the year 1958-59 according to figures furnished by the State Government. Revenue collections have generally increased over the years that is, from Rs. 38.4 lakhs in 1953-54 to the above figure in 1958-59. The average for the period 1956-57 to 1958-59 amounts to Rs. 58 lakhs for the district. This is nearly Rs. 2 per acre of sown area. The incidence would be even higher if we considered the assessed figures of land revenue. Percentage collections to demand have varied over the years and in general have been high in the colony areas. The generally larger collection of revenue for assessed population is evident from the above estimates. It need hardly be mentioned that a greater part of the revenue of the district is contributed by the colony. This aspect has been examined in more detail in a subsequent Chapter. Some of the more important statistics of the district may be seen in the table below :

TABLE NO. 2·8

*Selected District statistics**

Items	Number		Per cent	
1	2		3	
1. (*i*) Agri. population	5,10,892		81·08	
(*ii*) Non-Agri. population	1,19,238		18·92	
TOTAL	6,30,130		100·00	
2. *Cooperative societies*	*No.*	*Per cent*	*Member-ship*	*Per cent*
(*i*) Colony tehsils	494	64·7	21,761	72·3
(*ii*) Non-colony tehsils	270	35·3	8,351	27·7
TOTAL	764	100·00	30,112	100·0
3. *Educational institutions*		*No.*	*Per '000 population*	
(*i*) Institutions		485	0·77	
(*ii*) Total students		40,356	64·6	
4. *C.D. & N.E.S. Blocks*		*No.*	*Percentage of total village population*	
(*i*) Number		5	63	
(*ii*) Villages covered		11,73	50	
(*iii*) Population covered		3,18,000	50	
5. *Income and Expenditure*	*Income*	*Per cent*	*Expenditure*	*Per cent*
(*i*) Colony tehsils	31,23,107	60·9	236,336	57·7
(*ii*) Non-colony tehsils	20,05,749	39·11	1,72,616	42·3
TOTAL	51,28,856	100·04	4,08,942	100·0
6. *Per Capita*:				
(*i*) Colony		9·43		0·71
(*ii*) Non-colony		6·71		0·58
TOTAL		7·98		0·65

*Statistical outline of Ganganagar District.

N.B..—Data relates to the year 1957-58 except for item 1 which is based on Census 1951.

CHAPTER III

DESIGN OF THE INQUIRY

Area of Study and stratification : (*Rural Studies*)

1.0 The total area irrigated by the Gang canal during 1958-59, was 7.24 lakh acres that is, approximately the same as the commanded area of 7.5 lakh acres. For the purposes of the study, the universe was reduced to 5.3 lakh acres, firstly, by excluding the areas served by channels located along the border, that is, within a maximum distance of 6 miles from the Indo-Pak boundary and, secondly, by eliminating very small channels (minors) or those with a command of less than 2,500 acres. Thus two distributaries (or 6 per cent of total) and about 37 minors (or 41 per cent of total) were excluded from the universe. From the point of view of the study of benefits of irrigation, exclusion of these areas was not considered likely to affect the results of the study, as the area under the command of the Gang canal was fairly homogeneous in respect of conditions of soil, crops, distribution of rainfall etc. Besides, the border areas under irrigation did not present any features which might otherwise significantly affect the results of our enquiry.

1.1 For a statistical study of the type envisaged here, the adoption of census method was obviously not practicable. Considering the limitations of cost and time, the method which could yield reliable results was one of stratified random sampling. Since the effects of irrigation had to be identified and measured, the major criteria for stratification of the area that could be adopted with advantage were (*a*) security and assuredness of water supplies, that is, the intensity factor and (*b*) the age of the channels or more appropriately the period for which irigation had been made available, that is, the time factor. The soil-crop complex, being fairly uniform in the area, could not be taken into account for any major divisions or stratification of the area but it was taken as an important differentiating factor at the sub-sampling stage. In respect of the period of water supplies and the element of security that is, whether irrigation was perennial or non-perennial or limited to one crop only, important differences were found which would directly affect the size and direction of benefit. On this basis, therefore, two major zones of study were demarcated.

1.2 A further stratification or sub-division of the zones related to the category of channels, that is, major branches or distributaries and smaller branches or 'minors'. The average commanded area under the minors was observed to be generally lower than for villages which were under the command of distributaries. On further study, however, it was noticed that such differences depended more on extraneous factors like topographical characteristics etc. and were not significant for a study of farm economy in the area. The villages and farms have, therefore, been grouped under two sub-divisions in each zone to correspond to the differences in soil-crop conditions.

Three Stage Sampling

2.0 For each of the major zones of study, that is, perennial and non-perennial, a list was prepared showing the area commanded by the various channels separately for the distributaries and minors. A specified number of channels was then selected from the lists at random with probability proportional to size, the size being the area commanded by the channels. Thus, in all, 8 channels including 4 major distributaries were selected which in terms of commanded area cover about 12 per cent of the project area(1). At the second and third stage sampling, a fixed number of *chaks* and cultivating and labour house-holds as per sampling design were selected, again on a random basis, giving an overall sampling proportion of about 2 per cent of agricultural households in the colony assuming an average of 5 persons per household. Table No. 3.0 indicates the selected channels, *chaks* and households :

TABLE NO. 3·0

Number of villages and households in sample strata

Zone/Strata/Channel	Villages	Households		
		Farm business	Labour	Total
(1)	(2)	(3)	(4)	(5)
Perennial :				
Ganganagar-Padampur area :				
Thakranwali	8	51	33	84
Rasulpur	6	56	73	129
B. B. Padampur	15	97	57	154
Anupgarh area :				
G. B. Karnjiji	15	86	37	123
G. B. Bijeynagar	7	64	32	96
Total (Perennial)	51	354	232	586
Non-perennial :				
Ganganagar area :				
L. N. P. II	2	14	9	23
L. N. P. V	1	7	2	9
Raisinghnagar area :				
Bhompura	1	3	—	3
Total (Non-perennial)	4	24	11	35
Total irrigated :	55	378	243	621
Control	10	119	14	133
Grand Total : (Irrigated and control) ..	65	497	257	754

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(1) The total Culturable command of selected channels is 95,402 acres.

2.1 For the purposes of selection of households, a self-weighted design was worked out, considering that in the selected *chaks,* generally 1/6th of the cultivating households or labour families, would be sampled out for intensive studies except for *chaks* under minor channels in perennial zone where about 1/3rd of the total households would be selected. The sample so worked out comes to 754 rural house-holds which would ensure an unbiased estimate even if simple aggregative averages were used in estimating the benefits.

Control Units

3.0 The selection of control sample presented certain difficulties. The uncommanded area in the proximity of the project was extremely limited. Settled habitations outside the project area were few and while there were in all about 30 villages situated at varying distances from the extreme end of canal zone, the number that could possibly be considered for drawing up a frame was even less. Some of these villages were extremely small with only 6 to 10 households and some were deserted. Further some villages which were partly irrigated or were situated on the fringe of the colony had to be eliminated. Randomisation thus being made virtually impossible, selection had to proceed on a more purposive basis, the main criteria adopted being that the control villages should be proximate to the commanded area that is, within a maximum limit of 10 miles and that the villages should otherwise be similar to those on the western bank of the canal. On this basis, 10 control centres or 'Barani' villages were selected. A full description of these villages is given elsewhere. It might, however, be mentioned here that considering the uniform character of the economy of these villages and the drab similarity of the uncommanded area in general selection of 10 villages in the control sample was considered quite adequate. In these villages as well, about 1/6th of the cultivating households or a minimum of 10 farms per village were sampled out for a study of their farm business In all 133 households were sampled for intensive studies in these villages.

Urban Studies

4.0 For the study of non-farm activities which have been termed as 'urban studies' because of the concentration of the industrial and trading activities largely in urban centres or mandis, the principal consideration was that the investigation should be limited to such towns as were close to the project area and which were market towns for the produce of the project villages. They should also be focal points of traffic flows from nearby irrigated villages. Those which were outside the project area and otherwise were mainly served by the barani villages were designated as control towns. Of the 11 towns in the District, 4 towns had a population of less than 5,000 but otherwise possessed certain urban characteristics. These four were excluded from the frame in view of their small size and also because two of these were located very near the Pakistan border. There were thus 7 urban centres in all, 3 in the colony and 4 in the uncommanded area of the district with a population ratio as 2 : 2. Two towns that is, the Divisional town of Sriganganagar and Raisinghnagar were selected in the project area while Hanumangarh was chosen as a control town. In addition to these, Padampur mandi in the colony was also included in the urban studies in view of the special concentration of industry here.

4.1 As a first step, an establishment census covering all units in industry and trade sectors was carried out in the selected centres. The census gathered information on such aspects as type and size of production or business carried out, number of persons employed, size of investment, etc. The census covered in all 1,241 industrial units and 1,860 trading establishments. From the lists so provided, a total sample of 107 industrial units was selected for intensive studies. This works out to an overall sampling fraction of about 9 per cent. The sampling fraction was, however, not uniform as between different categories of industries and in various centres. A higher sampling fraction was allowed for in the selection of processing activities as in the particular context of our study, it was in processing activities that the extended effects of irrigation would be felt most. Besides 146 trading establishments or 8 per cent of total were selected for the study of different aspects of business activity.

5.0 In all, considering both rural and urban studies together over 8,235 schedules and enumeration sheets were filled up in various rounds, covering both rural households and urban establishments. Of this about 6,690 were filled up in the main area of study that is in project villages and towns. From these units, information on a variety of aspects was gathered through a set of questionnaires and other forms specifically designed for the purpose. These are in addition to the village forms for all the selected villages in which relevant statistical and descriptive material was assembled. The following table sums up the distribution of the sample under various enquiries.

TABLE NO. 3·1

Sample units for various enquiries

Rural studies	Project	Control	Total
1	2	3	4
Rural studies :			
1. Enumeration (Total households)	3243	876	4119
2. Farm Business Survey	378	119	497
3. Agricultural Labour	243	14	257
Total	3864	1009	4873
Urban studies :			
4. Census			
(*a*) Industrial establishments	1069	172	1241
(*b*) Trading establishments	1544	316	1860
5. Industry	90	17	107
6. Large Industrial Units (Case studies) ..	7	1	8
7. Trade	119	27	146
Total	2829	533	3362
Grand Total (Urban and Rural) ..	6693	1542	8235

5.1 The study formally commenced in December, 1958, with the initiation of pilot study to test the schedules and provide necessary training to investigation staff. The first round of farm business survey was commenced towards the end of the year, 1958 and the field work covering both rural and urban study was completed in July-August 1959. The interim report on farm business survey was completed in February, 1960 and the main findings were considered by the Committee of Direction in March, 1960. Subsequently, tabulation and analysis of data related to secondary benefits (urban survey) were completed in September, 1960.

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CHAPTER IV

ECONOMY OF THE SELECTED VILLAGES

Introduction

1.0 As a part of the present study, some older residents in the colony were interviewed for their personal impressions regarding the state of their villages before and after the advent of the canal. An aged Sikh peasant describing the conditions of his village in the pre-canal period made the typical observation that it was all barren with heaps of sand all over the land. Only a few families had any land in the village. There were no roads except undulating foot paths and the children and the aged people came to the village on camel backs paying exorbitant charges. In other villages also, the older residents had the same story to tell. Harvests were poor, employment scarce and the return from land was just enough to meet the land revenue charges. Now it is a totally different picture; the land-scape has vastly changed; smiling fields have replaced desolate waste and villages hum with activity at harvest time. All the same, within a few miles from the extreme end of the canal zone in the barani villages conditions have remained fairly static and provide a glimpse of life in the olden days.

1.1 In this chapter we have attempted to describe the main economic features of the sample villages based upon analysis of village survey data for the reference year. As the study is concerned with the impact of irrigation, the distinction between irrigated and unirrigated samples is maintained throughout the report in presentation of data relating to various aspects of village economy. The analysis of data seeks to bring out the impact of irrigation in both absolute and relative terms. The general stratification followed in the study has already been indicated in Chapter III. Thus the main divisions in the commanded area are the perennial and non-perennial zones. The former includes samples drawn both from the Ganganagar and Padampur Tehsils as also from Anupgarh. Conditions in these are, however, not similar. While in the tables data have not been presented separately for different areas, attention has been drawn to significant differences and where necessary data have also been presented separately. Similarly figures for non-perennial zone are largely representative of conditions in *chaks* under the Lalgarh non-perennial channels. This zone also includes one *chak* under the Sameja in Raisinghnagar which is more close to Anupgarh. This village could be said to represent a transitional stage from dry farming to irrigated farming. Some inter-village differences are also observed in the Barani area, although the variations are not substantial. In general, the differences in various characters studied are not uniformly significant to merit any further detailed presentation of statistics.

TABLE NO. 4·0

Locational particulars of Villages

Distance from Village	Irrigated Villages									Barani Villages		
	Perennial			Non-Perennial			Total					
	Road	P.O.	Rly. St.	Road	P.O.	Rly. St.	Road	P.O.	Rly. St.	Road	P.O.	Rly. St.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Upto 2 miles	33	21	14	3	3	—	36	24	14	4	1	1
2-5 miles	10	25	1	1	—	—	11	25	11	3	5	4
Over 5 miles	8	5	26	—	1	4	8	6	30	3	4	5
TOTAL	51	51	51	4	4	4	55	55	55	10	10	10

Location area and population features

2.0 As regards the distribution of sample villages by broad locational characteristics, it would be seen that the commanded villages are, in the main, more communicable (Table No. 4.0). Most of the chaks are within reach of transport and communication systems and well served by markets. For instance two-thirds of the chaks in the Canal zone are located within a distance of 2 miles from a pucca or motorable road and 44 per cent have also a post office nearby. A good number of the villages are also accessible by the canal railway which threads throughout the length of the irrigated tract. Besides the main roads, there are many village roads and the boundary roads along the canal banks which the villagers use freely. The Barani Villages, on the other hand, are not so favourably located and communications are far from developed in this area. Out of the 10 selected villages, 4 have motorable roads within two miles while one village in Padampur has a railway station and post office within easy reach. The roads here often get choked with growth of wild bushes making it difficult for villagers to ply even their bullock carts. Moderately heavy rains disrupt all communications between these villages.

2.1 From the figures in Table No. 4.1 showing area and population particulars it is evident that the size of an uncommanded village is much larger being on an average 6 times that of an irrigated area is 9,274 acres or are larger in the Anupgarh area where the average area is 9,274 acres or 54.8 per cent above the general average. Thus while the 10 barani villages have an area of 60,000 acres, the chaks in the irrigated area which are over 5 times in number have a total geographical area of 48,236 acres or on an average 880 acres per chak. The chaks in the colony were originally carved out to conform to a prescribed limit of an area of about 50 squares or nearly 780 acres. The present area of the sample village is somewhat larger. On the other hand, the size and growth of the barani villages have been conditioned more by the physical characteristics of land and the all important factor of availability of water supply.

TABLE No. 4·1

Area and population of selected villages

Particulars	IRRIGATED			BARANI
	Perennial	Non-Perennial	Total	
(1)	(2)	(3)	(4)	(5)
1. No. of villages	51	4	55	10
2. Area (acres)	44,995 (882)	3,240 (810)	48,236 (877)	59,864 (5986)
3. No. of Households	2,898 (57)	345 (86)	3,243 (59)	876 (88)
4. Persons	14,952 (293)	1,951 (488)	16,903 (307)	4,242 (424)
5. Per capita area (in acres)	3·0	1·6	2·9	14·1

Figures in brackets are averages

2.2 The differences in general characteristics of the villages are further brought out in Table No. 4.2 which compares villages in the two areas of study by geographical area and population ranges. While the barani village is conspicuously large in area, the size of population in comparison to colony chaks, is not equally significant. For instance, while there are normally 88 households or 424 persons in a barani village, an irrigated chak has about 60 households with 307 persons. The average population of barani village is thus only 37 per cent higher. Further, while more irrigated chaks have a population of less than 500 each, a larger proportion of the barani villages have population varying between 200 to 1,000. The contrast in the concentration of population that these figures indicate is further reflected in the figures of per capita cultivated area, which in the colony works out to 2.5 areas as against 8 acres in the uncommanded zone. The per capita figures disclose even more strikingly the difference in density in relation to total geographical area that is, 3 acres per capita in the colony and 14 acres in the barani area. Within the colony there is relatively greater farm land in Anupgarh, and in the chaks in the immediate neighbourhood of Ganganagar. In the later area, it is due to the fact that the better and well to do farmers reside in the town so reducing the resident population of the chaks, where mainly share-cropper and other wage earners reside. In the non-perennial zone, however, the density is higher, the per capita area being 1.6 acres. The average population has been observed to be the maximum in the villages studied. This has, however, nothing to do with the character of irrigation supplies because this is an area where land was colonised early and chaks have been in existence for a fairly long time.

TABLE NO. 4·2

Distribution of selected villages by geographical area and population ranges

particulars	Perennial	Non-perennial	Total Irrigated	Barani
(1)	(2)	(3)	(4)	(5)
Village area range (acres per village)				
Less than 600	1	1	2	—
600—800	17	1	18	—
800—1,000	23	2	25	—
Over 1,000	10	—	10	10
Total	51	4	55	10
Population range (Persons per village) ..				
Less than 200	14	1	15	1
200—500	33	2	35	5
500—1,000	4	1	5	4
Over 1,000	—	—	—	—
Total	51	4	55	10

Structure of family and earning persons

The size of the family on an average is slightly larger in the project villages, being 5.2 persons as against 4.8 persons in the villages outside the commanded area. In a few cases within the project area, particularly in the villages under the command of non-perennial channels, the average family is observed to be even larger with six persons. On the contrary, in the barani villages situated in the Anupgarh area the average family consists of four persons. The average cultivated household again is larger in the commanded villages.

3.1 As regards proportion of earners to non-earners including earning dependents in the family, it is observed to be generally comparable in all the zones of study (Table No. 4.3). Within each zone, however, some differences are noticed. For instance, in the Ganganagar-Padampur tract, both within the colony and outside it, the proportion of earners is low as compared to villages in the Anupgarh area. In the colony, the percentage of earners is again lower in the perennial zone while in the non-perennial zone the distribution is similar to that in the Barani village.

TABLE No. 4.3

Earners and non-earners

Zone	Earners		Non-earners		Total Persons
	Persons	Per cent	Persons	Per cent	
(1)	(2)	(3)	(4)	(5)	(6)
Perennial	6728	45	8224	55	14952
Non-perennial	906	46	1045	54	1951
Total (Irrigated)	7634	45	9269	55	16903
Barani	1965	46	2277	54	4242

Occupational structure

4.0 Particulars of households and persons enumerated and classified by the principal occupational categories are indicated in Table No. 4.4. The classification is based chiefly on the principal occupation as well as the major share of the earnings under this source as reported by the head of the household. A very large proportion of the household is obviously engaged in agriculture; over 60 per cent of the families in the irrigated chaks are thus cultivator families deriving their main sustenance from farming. The term "cultivator family" however, is not restricted to persons who actually till the land but includes all those who cultivate land, irrespective of the size of holding, as owners, share croppers etc. The pure rentiers were very few and have been treated as non-cultivators. It would be observed from the table that the proportion of cultivator families is the highest in the control area where it is 94 per cent. On the other hand, there are more of labour households in the irrigated chaks particularly in the perennial zone. On

TABLE NO. 4.4

Number of Households and Persons by Principal Occupations

	IRRIGATED						BARANI	
	Perennial		Non-Perennial		Total			
	Households	Persons	Households	Persons	Households	Persons	Households	Persons
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Cultivation	1753 (60)	9570 (64)	255 (74)	1408 (76)	2008 (62)	11,058 (65)	821 (94)	3979 (94)
Labour	910 (31)	4271 (29)	72 (21)	382 (20)	982 (30)	4653 (28)	43 (5)	210 (5)
Industry	54 (2)	307 (2)	2 (1)	13 (1)	56 (2)	320 (2)	1 (0)	15 (-)
Trade	42 (2)	198 (1)	5 (1)	20 (1)	47 (1)	218 (1)	1 (0)	3 (-)
Professions & others	139 (5)	606 (4)	11 (3)	48 (2)	150 (5)	654 (4)	10 (1)	35 (1)
TOTAL	2898 (100)	14,952 (100)	345 (100)	1951 (100)	3243 (100)	16,903 (100)	876 (100)	4242 (100)

Note.—Figures in brackets represent percentages to related totals.

further analysis, it would appear that there is greater concentration of labour households in the chaks around Ganganagar. Correspondingly, therefore, the cultivator families resident in the villages here, are relatively less. This position, however, is reversed in the Raisinghnagar and Anupgarh areas where the relative proportion of cultivators is higher and the general occupational structure becomes somewhat comparable to the barani area. In the barani area, overwhelming proportion of families have reported agriculture as their source of livelihood. The figures are based on the data gathered in the first round. Subsequently, however, at the stage of intensive studies, it was noticed that a large number of households which are reportedly cultivator households also derived a substantial part of their earnings through wage services.

Labour

4.1 Labour is mainly of the landless category and the earnings from land where it has been acquired are meagre, the main characteristics of these labour families have been discussed in some detail elsewhere in this report (Chapter VIII). Most of these families are 'local' in origin comprising the principal communities of 'Meghwals' and 'Bawaris' which were mainly pastoral before the advent of the Gang Canal. The farm labour in the colony is mainly drawn from adjacent barani villages and not infrequently from the neighbouring districts of Bikaner, Jodhpur and Jaisalmer. In most cases it has been observed that they migrate from these areas to the colony in search of farm work particularly during kharif season. In the winter months, however, they return to their villages, causing thereby some scarcity of labour for rabi operation in the colony. The need for farm labour arises mostly when either farmers' own labour and that of the members of his family is not adequate to cope with farm operations and the need increases with the scale of operations. There is no doubt that the colony area through intensive methods of farming and greater cultivation has grown into an important source of employment in the region drawing its labour supply from within and outside the district. This is well brought out by the figures in Table No. 4.4 which show that about 30 per cent of the families in the canal zone are labour households almost exclusively agricultural workers while in the uncommanded villages such households constitute only 5 per cent of the village population. Labour households are particularly significant in the chaks in Ganganagar, as greater number of land-owners reside in the city while their farms in the *Chaks* are entrusted to permanent farm servants or 'Siris'. Thus there is greater demand for paid labour of all categories—both casual and permanent.

4.2 Paid labour is mostly utilised in the operations of weeding, harvesting and threshing and the system of engaging labour is similar in both the commanded and uncommanded villages. The usual type of labour is the casual-daily-rated labour paid either in cash or kind or both. In the barani villages labour is mostly unattached and casual. The system of contract labour also prevails in this area and wages are paid either in cash depending upon the area of the farm or in kind, often as a share of the harvested crop. While wage rates vary between different seasons and crop operations, they also differ between chaks. For instance, the daily rate for casual labour may vary in the irrigated zone from Rs. 1.50 to as much as Rs. 5, and in the colony chaks meals are sometimes given in addition. In the Barani villages, on the other hand, the wages are lower and vary from Rs. 1 to Rs. 3 and are comparable to the prevailing rates in Anupgarh *chaks* where farm labour is cheaper. Labour is scarce at harvest time particularly for rabi and wage rates, therefore, go up. In the case of permanent farm servants or 'Siris' the salary or annual payments might vary between Rs. 300 to Rs. 800. Normally the payments are both in cash and kind. Female and child labour is not generally prevalent whether in commanded or uncommanded area except for certain operations like weeding and nipping of cotton. In the latter case particularly, female labour is the most significant. The general rate for nipping of cotton is 6 nP. per seer and payments in kind mostly in the form of dry cotton stalks are also not uncommon.

4.3 Apart from these two main classes, the number of persons engaged in industry or artisan activities is very small being only 2 per cent of the total population. There are hardly any weavers or other persons professing other skilled arts and crafts. Such services, if any, are mainly concentrated in the market towns. The last group in the table relates to the miscellaneous categories of professions and services including the unemployed and beggars. The highest proportion of 5 per cent in this category is observed in the Ganganagar *chaks.*

Land Utilization

5.0 An irrigation project makes an impress primarily on the land use in the area under its command by facilitating an extension of cultivation or reduction of unutilized land resources. This is clearly brought about by the figures in Table No. 4.5. Thus, for instance, although in absolute area the cultivated land is much larger in the barani village a feature incidental to the size of the barani villages, in relation to the village area, however, cultivation extends to 92 per cent in the project area as against 58 per cent in the uncommanded area. In the commanded villages again, more area is sown with crops that is, 82 per cent of the total land or 89 per cent of the cultivated area. On the other hand, in the barani villages sown area accounts for 25 per cent of the village area and 44 per cent of cultivated area. In this zone not only the proportion of uncultivated land is much larger but that the current fallows are even relatively higher in comparison to available cultivated area. The figures of fallow area may be used with some caution for some of this area consists of permanent fallows or land that has gone out of cultivation for some years even though it might be recorded as current fallows in the village papers. It would also be observed that fallow land constitutes well over half of the cultivated area in the barani villages while this is about 11 per cent in the project area. Even here, the fallows were observed to be much larger in the southern reaches of the canal that is, in the Ganganagar chaks.

5.1 The uncultivated area including culturable wastes approximates to 8 per cent in the project zone as against 42 per cent in the uncommanded zone. Both in this respect as also under cultivated area there is no marked difference between the perennial and non-perennial zones. From a break-up of the uncultivated area it would appear that this area in the main comprises of waste land 'Tibbas' or (Sand dunes) where in view of their elevation cultivation is rendered difficulty. Indeed water is crucial in this area determining largely the scope for extension of cultivation. It was observed that in the year of reference hardly 10 per cent of the cropped area did not receive any irrigation.

5.2 A comparison of figures of sown area in the perennial and non-perennial zones suggest that more crops were sown in the non-perennial zone. This evidently has determined the higher crop intensity in this zone which is 112 as against the general average of 96 for the commanded zone. Between different villages marked differences in crop intensity had been observed. For instance, intensity was high in the chaks under Lalgarh channels in the Ganganagar Tehsil while it was lowest in the Anupgarh area. Similar differences were also observed in the uncommanded villages in Anupgarh Tehsil which had very low crop intensity and maximum fallow area.

6.1 The most noteworthy feature is the diversity in the cropping pattern in the irrigated areas. More crops are grown within the colony than without, which is due as much to provision of irrigation as perhaps to the enterprising peasantry in the colony. The purely irrigated crops are sugar cane, cotton and rice which are intensive in their requirements of water. Cotton is an important kharif crop in the colony while wheat and gram are the principal winter crops. Cultivation of rice is mainly in the Ghaggar bed in Anupgarh where the soil characteristics are particularly suited to raising of this crop. It would be observed again that feed crops mainly jowar, gowara and barseem cover about 14 per cent of the area in the colony. I is slightly more in the non-perennial zone. The importance of cattle fodder in an area where cattle are mainly stall-fed is shown by these figures. Besides they seem to indicate that in this respect the irrigated chaks are mainly self-sufficient and do not draw much of the crop from outside the colony.

6.2 In the colony while the general distribution of food and other crops is fairly comparable between the two zones that is, perennial and non-perennial, individual crop acreages, however, show variations. For instance, in proportion to gross cropped area there is more of cotton, grams and fodder

TABLE No. 4.5

Land Utilisation in Sample Villages

Zone/area	Perennial		Non-Perrennial		Total Irrigated		Barani	
	Acres	Per cent	Acres	Per cent	Acres	Per cent	Acres	Per cent
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1. Cultivated area ..	41,363·31	91·93	2,999·16	92·56	44,362·47	91·97	34,737·08	58·03
(*a*) Sown area ..	36,505·35	81·13	2,850·06	87·96	39,355·41	81·59	15,152·62	25·31
(*b*) Current fallows	4,857·96	10·80	149·10	4·60	5,007·06	10·38	19,584·46	32·72
2. Uncultivated area..	3,632·06	8·07	240·97	7·44	3,873·03	8·03	25,126·93	41·97
3. Total area (1 plus 2)	44,995·37	100·00	3240·13	100·00	48,235·37	100·00	59,864·01	100·00
4. Gross cropped area	39,308·53	100·00	3,360·34	100·00	42,668·87	100·00	15,426·69	100·00
(*a*) Irrigated* ..	35,708·54	90·84	2,972·03	88·44	38,680·57	90·65	—	—
(*b*) Unirrigated* ..	3,599·99	9·16	388·31	11·56	3,988·30	9·35	15,426·69	100·00
5. Percentage crop Intensity	—	95·03	—	112·04	—	96·18	—	44·41
6. Percentage to cultivated area (row 1)	—	—	—	—	—	—	—	—
(*a*) Sown area ..	—	88·26	—	95·03	—	88·71	—	43·62
(*b*) Current fallows	—	11·74	—	4·9	—	11·29	—	56·38

*Figures in percentage cols. relate to gross cropped area given in row (4).

$$\text{Percentage crop intensity} = \frac{\text{Gross cropped area}}{\text{Cultivated area}} \times 100$$

TABLE No. 4.6

Area under principal crops

Crops	Perennial		Non-Perennial		Total Irrigated		Barani	
	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1. Sugar Cane	979	2·49	5	0·14	984	2·31	—	—
2. Cotton	8,965	22·81	1040	30·95	10,005	23·45	—	—
3. Paddy	839	2·14	—	—	839	1·96	—	—
4. Wheat	10,299	26·20	236	7·04	10,535	24·68	1194	7·74
5. Gram	3,437	8·74	819	24·38	4,256	9·97	1782	11·56
6. Mixtures	3,579	9·10	496	14·73	4,075	9·56	3238	20·99
7. Oil Seeds	4,108	10·46	127	3·78	4,235	9·93	5467	35·44
8. Fodder	5,314	13·51	537	15·99	5,851	13·71	61	0·39
9. Miscellaneous crops	1,789	4·55	100	2·99	1,889	4·43	3685	23·88
TOTAL	39,309	100·00	3360	100·00	42,669	100·00	15427	100·00

crops in the non-perennial zone as compared to perennial zone. In general, there is greater area given to kharif crops in the former zone in view of the water supply being mainly limited to the kharif season. These figures seem to reflect mainly the cultivators' preferences and efforts to make the maximum use of canal supplies which are assured in the kharif season. On the contrary, in the perennial zone, there is more area under wheat and oilseeds in rabi and on annual crop like sugar cane which is a rather important crop in Anupgarh.

6.3. Without irrigation, cultivation appears to be confined mainly to the Rabi crops. For instance, over 80 per cent of the total cropped area in the barani villages is under rabi crops, the most important being oilseeds which again are grown largely in Anupgarh. Even here, somewhat inferior crops like the taramira and toria are grown while in the commanded zone, mustard is more important. Other crops like wheat and gram or more frequently mixtures of these are more extensively grown in the Ganganagar and Padampur villages. The larger area under mixed crops is obviously an insurance against possible crop failure. The fodder acreage again is negligible because fodder is not such a vital necessity in this area where cattle are sent out for grazing.

6.4 The figures given above suggest that canal irrigation affects appreciably cropping practices and promotes greater cultivation of cash crops like sugar cane, cotton etc. In the absence of assured supplies, however there is marked preference for crops which mature early and need less waterings. Recent improvements in water supply in the non-perennial zone would thus appear to have been mainly used for extending the total acreage under crops rather than adoption of crops which are intensive in their irrigational requirements but which would ultimately have restricted the total acreage. This is evident also from figures of percentage crop intensity and double cropping both of which are higher than the colony averages.

Implements and agricultural machinery

7.0 An inventory of farm implements in the selected villages suggests that while in the barani villages there are implements, the chaks in the commanded area possess more of improved and better types of implements. On an average an irrigated chak has about one tractor, 16 bullock carts and 25 iron ploughs as against nil, 1 and 13 respectively in the uncommanded villages (Table No. 4.7). Traditional implements are more in use in the uncommanded area and this can be seen from the higher figures under an item like the wooden plough. Even here relatively to the cultivated area, there are fewer ploughs in the barani villages or about 35 per thousand acres which is evidently less than half the number obtaining in the corresponding irrigated chaks (Table No. 4.8). This difference, of course is conspicuously larger if we consider other implements. All in all, it appears that per thousand acres of cultivated area there are over 3 times the number of implements in an irrigated chak as compared to the uncommanded village. Within the

TABLE No. 4.7

Distribution of implements in sample villages

Implements	IRRIGATED						BARANI	
	Perennial		Non-Perennial		Total			
	No.	Average	No.	Average	No.	Average	No.	Average
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Agrl. Machinery :								
(*i*) Tractors	53	1	10	3	63	1	2	—
(*ii*) Ghanis	—	—	1	—	1	—	—	—
(*iii*) Pumps	1	—	—	—	1	—	—	—
TOTAL (*i-iii*)	54	1	11	3	65	1	2	—
2. Bullock-carts	830	16	42	11	872	16	12	1
3. Ploughs	4054	80	672	168	4726	86	1357	136
(*i*) Iron	1272	25	135	34	1407	26	132	13
(*ii*) Wooden	2782	55	537	134	3319	60	1225	123
4. Cane-Crushers	405	8	2	1	407	7	1	—
5. Fodder Cutters	36	1	—	—	36	1	—	—

commanded zone, the chaks under non-perennial channels are better equipped in respect of tractors and ploughs. The tractors, however, are largely owned by the bigger farmers residing mainly in Ganganagar, who have their lands in adjacent chacks both under perennial and non-perennial irrigation. Considerable farm produce from these villages is transported to the 'Mandi' by means of tractors besides bullock carts. On the other hand in the uncommanded villages, bullock cart is rarely seen. Most of the village produce here is carried on the back of a camel which besides being the most important draught animal also provides the chief means of transport. Apart from this, chaks in the perennial zone particularly in Anupgarh have reported more of cane crushers. This, obviously, is an implement which would be conspicuous, in villages with a concentration of sugar cane cultivation.

TABLE NO. 4.8

Distribution of implements in sample villages (Per 100 acres of cultivated area)

Implements	Perennial	Non-Perennial	Total Irrigated	Barani
(1)	(2)	(3)	(4)	(5)
Tractors	1·3	3·3	1·4	0·1
Bullock-Carts	20·7	14·0	19·7	0·4
Ploughs	98·0	224·5	106·5	39·1
(*i*) Iron	30·8	45·0	31·7	3·8
(*ii*) Wooden	67·2	179·5	74·8	35·3
Cane Crushers	9·8	0·7	9·2	—
Fodder cutters	0·9	—	0·8	—

Livestock

8.0 Figures in table No. 4.9 show the distribution of livestock by the principal categories and those in table No. 4.10 present the same information in relation to cultivated area. Here again, the total number of animals is larger in a barani village. For instance, the draught animals on an average are 98 per cent higher in the barani village while in respect of milch animals the difference is nearly 54 per cent. These differences are due to the differences in the size of the village in both the areas. In relation to cultivated area, however, it would be seem that except for camels, there are more of both plough cattle and milch animals in the commanded chaks (Table No. 4.10). For instance, bullocks are over 3 times the number while she-buffaloes are over 6 times the strength obtaining in barani villages. There are, however, more camels in the barani area, an animal which is usually reckoned as equal to two bullocks, and which otherwise is eminently suited for draught purposes in the semi-arid conditions of the region.

TABLE No. 4.9

Total and average livestock in sample villages

Category of animals	Perennial		Non-Perennial		Total (Irrigated)		Barani	
	No.	Average	No.	Average	No.	Average	No.	Average
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Draft animals	4861	95	391	98	5252	96	1898	190
Bullocks	4340	85	169	42	4509	82	1009	101
Camels	521	10	222	56	743	14	889	89
Milch animals	4521	89	486	122	5007	91	1398	140
Cows	1883	37	242	61	2125	39	1050	105
Buffaloes	2638	52	244	61	2882	52	348	35
Other animals	8165	160	936	234	9101	166	9536	964
Sheep and Goats	6718	132	902	226	7620	139	9461	946
Horses and Ponies	127	3	14	4	141	3	33	3
others	1320	26	20	5	1340	24	42	4
Young Stock Calves and Heifers ..	4441	87	664	166	5105	93	1188	119
Breeding Animals	32	1	4	1	36	1	10	
Others	45	1	—	—	45	1	155	16
GRAND TOTAL	22065	433	2481	620	24546	446	14185	1419

TABLE NO. 4.10

Draught and milch cattle per 100 acres of cultivated area

Animals	Perennial	Non-Perennial	Total	Barani
(1)	(2)	(3)	(4)	(5)
Draught Animals	11·8	13·0	11·9	5·5
Bullocks	10·5	5·6	10·2	2·9
Camels	1·3	7·4	1·7	2·6
Milch Animals	11·0	16·2	11·3	4·0
Cows	4·6	8·1	4·8	3·0
Buffaloes	6·4	8·1	6·5	1·0

8.1 Within the commanded zone again there are more camels in the non-perennial zone, a feature that is more characteristic of barani area. In respect of milch animals as well, there are more heads in the non-perennial chaks. This is particularly so when we consider their number in relation to the cultivated area. In the barani area, on the other hand, cows are more in number.

8.2 Besides these animals, sheep and goats are the most important other animals' in the uncommanded villages. On an average there are 946 animals in this category. This is to be expected as sheep rearing is an important and paying industry for the people in barani villages especially those in the Anupgarh area where the number of such animals is the highest. Likewise, the young stock are more in the barani villages. This is, however, not an indication of the greater livestock industry in this area. Finally, there is on an average one breeding animal per village in both the barani and non-perennial zones, while in the perennial zone, it is even less.

Methods of Cultivation

(i) *Manuring Practices*

9.0 The cultivation practices vary markedly between commanded and uncommanded zones. Fertilisers are practically unknown in the barani villages and manuring, if any, is limited to farm yard manure. Apart from the insecurity attendent on an uncertain rainfall in this area, the application of manure represents a less paying proposition in comparison to the more profitable alternative of selling such farm yard manure to the cultivators in adjacent colony chaks where the demand is considerable. In the colony, on the other hand, the use of chemical fertilisers is extensive, the more common items being ammonium sulphate and urea. In the absence of any detailed enquiry into this aspect, it would be difficult to attempt any generalisations. No correlation however has been observed between extent of use of fertiliser and security in irrigation that is, because the water supply position is not very different in both the commanded zones. The use of Ammonia sulphate is fairly widespread in the colony while a more valuable item like urea is generally applied in limited quantities and mainly to crops like sugar cane and cotton. On a average, the acreage rate does not exceed one maund, although in terms of the number of applications, manuring for a crop like sugarcane is higher which is reflected in the higher average. (Table No. 4.11). It would also be observed that in the non-perennial villages the acreage rates of Ammonia sulphate are higher for cotton and wheat which are the principal crops here. Again cultivation is more intensive in Ganganagar and Padampur chaks in so far as the acreage rates here are reportedly higher. The proximity of Sriganganagar as also the more expensive cultivation of cash crops here account for the greater use of fertilisers. These are generally purchased from the mandi towns. Besides, the sugar factory at Sriganganagar also supplies a limited quantity, particularly urea to the producers on a loan basis, the value being recovered at the time of sale of sugarcane. Fertilisers are again supplied through the block agency although such distribution is reportedly limited and falls considerably short of the normal requirements of the farmers in the block villages.

TABLE NO. 4.11

Average rates of application of chemical fertilisers (Maunds per acre)

Zone	Fertilisers	Wheat	Paddy	Cotton	Sugar cane	Maize
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Perennial :						
Ganganagar ..	Phos	0·8	—	0·8	0·8	—
Padampur ..	A.S.	1·0	—	1·0	1·3	—
	Urea	0·4	—	0·4	0·4	—
Anupgarh ..	A.S.	1·0	1·2	1·0	1·7	0·9
	Phos	—	—	—	1·6	—
	Urea	0·8	1·6	1·1	1·8	0·4
Non-perennial :	A.S.	1·2	—	1·4	1·4	—

9.1 In contrast to the chemical fertilisers, the use of farm yard manure is much more extensive and liberal in the commanded area. There are no compost pits and cattle droppings alongwith other sweepings are preserved in open ditches. The chaks in Ganganagar-Padampur area whether under perennial or under non-perennial irrigation again show higher manuring in comparison to Anupgarh chaks. An exception is sugar cane which is heavily manured in the latter villages (Table No. 4.12).

TABLE NO. 4.12

Average rate of Farm yard manuring (Maunds per acre)

Zone	Wheat	Paddy	Cotton	Sugarcane	Gram
(1)	(2)	(3)	(4)	(5)	(6)
Perennial :					
Ganganagar/Padampur ..	219	—	225	263	138
Anupgarh	116	160	147	283	—
Total (Perennial)	196	160	203	272	138
Non-perennial	157	—	196	315	312
Total	193	160	203	274	141

9.2 Green manuring is hardly practised, as it is not considered necessary in view of the practice of leaving sufficient fallows. Besides the growing of crops like Gowara, Lucerene etc. partially serves the same purpose as green manuring. The normal practice is to spread the farm manure at the stage of preparatory tillage. The fertilisers are only applied at the seeding stage and sometimes also when the crop is nearing maturity. The fertilisers are generally heaped up at the sluice where water from the "Khalla" or water course enters the field. The canal waters thus get saturated with the fertilisers at the very outset. In this system, there is the risk that the fertilisers might get deposited and concentrated at the region near the outlet while the rest of the field would receive only a very thin application.

(ii) *Crop rotations*

9.3 There is no fixed or traditional rotation of crops and practice in this respect varies sharply from chak to chak and not infrequently from farmer to farmer. The following are only suggestive of the more popular rotations :

Paddy-gram-fallow-mustard or wheat.
Sugar cane-cotton-follow or gowar-wheat-cotton.
Sugar cane-fallow-wheat-cotton.
Cotton-wheat-or gram-cotton-gowar or bajra.
Sugar cane-fallow-wheat.
Jowar or gowar-barseem-jowar-or gowar.

9.4 The land is generally left fallow for a season or two after heavy irrigation. Thus for instance after sugarcane or paddy and sometimes cotton, it is common to leave the land fallow for a few months or alternatively the land may be sown with crops like jowar or Gowar which apart from their very light moisture requirements also serve as green manure. Thus a heavy crop would be followed by a lighter one such as gram after paddy, jowar or gowar after sugarcane etc., which replenishes the land. Fallows are generally a Kharif feature and it is in this season that the water supply position in the canals also becomes somewhat uncertain.

9.5., No special rotation is observed in the barani villages where cultivation is mainly limited to rabi crops. The following may be said to indicate the general practice in years of good rainfall :

Barley-wheat-barley
Kowar-gram-jowar
Taramira-gram or wheat.

(iii) *Sowing and harvesting seasons*

9.6 The farming practices are broadly similar in the commanded villages, although they are notably different from the more traditional methods still in vogue in the barani villages. The system of line-sowing with the help of seed drills often of a heavy variety is fairly common in the irrigated area while in the uncommanded villages seeds are generally broadcast. Transplanting of paddy is gaining in popularity and in this operation, the local landless community or 'Bawaris' have acquired considerable skill. The preparatory tillage again usually covers 3-5 ploughings in the irrigated area while it hardly exceeds 2 ploughing in the Barani villages. Besides the first few ploughings (preparatory tillage) in the irrigated area are done with heavy iron ploughs with consequent deep cutting. For this purpose tractors are also frequently employed. Subsequent ploughings however are carried on mainly with the help of wooden ploughs.

9.7 Harvesting in the barani areas is entirely dependent on rainfall; as such both prospect of a crop and the time of cutting are solely determined with reference to rainfall conditions. In the irrigated areas also Kharif crops are affected by the canal supplies. The harvesting of rabi crops is normally completed by April. The following gives the sowing and harvesting time for principal crops :

Crops	*Sowing*	*Harvesting*
Wheat	October	March-May
Cotton	March-May	September-Jan.
Paddy	July-August	October-Nov.
Paddy (early)	May	September
Sugarcane	March	November-Jan.
Mustard	Sept.-Oct.	April-May
Bajra/Gowar/Jowar	June-July	Oct.-Nov.

(iv) *Seeds*

9.8 In the irrigated chaks all the seed requirements are generally met from the previous crop except for cotton particularly long staple cotton and, to a much less extent, fodder crops. Only the villages which are nearer to Ganganagar have reported considerable purchases of seeds from the Ganganagar Mandi. On the other hand in barani villages almost all the seeds are purchased from either nearby mandis or from the adjacent irrigated chaks. Some seeds are also supplied through Block Development Agency but as in the case of fertilisers, the supply is far from adequate to meet the seasonal requirements of the farmers. The block agency supplies the improved seed usually on the basis of repayment in kind in the ratio of 1 : 1.15 maunds.

Educational Institutions

9.9 The economic characteristics of the sample villages have been considered so far. The more intangible effects of irrigation, being outside the scope of our study, no attempt was made at the collection of such data, although there is reason to believe that these are intimately related to the improvements in agriculture. From the data given in Table No. 4.13 it appears that while more villages in the barani area have schools, the number of children attending such schools is more in the commanded villages. This is also observed in the figures of school attending children in relation to the total village population. Most of these schools are primary level institutions.

TABLE No. 4.13

Villages with schools and number of school attending children

Particulars	Irrigated	Barani
(1)	(2)	(3)
1. No. of villages with school	12	5
2. Per cent of total villages	22	50
3. School going children		
(*i*) No. per village	109	52
(*ii*) No. per 1000 of population	77	62

Resume

10.0 The foregoing account brings out the widely varying characteristics of the sample villages in the two main areas of study. Without covering the ground over again, some of the more important indicators which sum up the contrasting positions of these two groups of villages are set out below. (Table No. 4.14).

TABLE No. 4.14

Selected economic indicators for sample villages and State

Particulars	Perennial	Non-Perennial	Total irrigated	Barani	Rajasthan*
(1)	(2)	(3)	(4)	(5)	(6)
1. Per capita area in acres	3	1·6	2·9	14·1	2·8
2. Percentage of culivators to total population	64	76	65	94	65
3. Percentage of cultivated area to total area	92	96	92	58	53
4. Sown area to cultivated area	88	95	89	44	68·8
5. Percentage intensity of cropping	95	112	96	44	75
6. Percenage area under cash crops	25·3	31·1	25·8	--	10·2
7. Impliments per 100 acres of cultivated area	13	24	14	4	6·3
8. Livestock per 100 acres of cultivated area	53	83	55	41	75

Source: Basic statistics of Rajasthan. 1962 Livestock census 1956.

10.1 These indices bring out the progressive character of the village economy and the greater wealth of the project villages. Some of these no doubt are incidental to the differences in general features of the villages under comparison in physical aspects and other conditions such as size, population characteristics etc. Thus for instance, the Barani villages are larger and the caste or community in these villages also is different from that of the project villages. In the latter, progressive farmers from Punjab with enterprise and knowledge of irrigation techniques might have influenced deeply the nature of farming and production techniques. The Barani villages, on the other hand, are largely inhabited by the 'local' communities, whose methods of farming do not appear to have changed appreciably. It is a matter for further investigation if farming has substantially changed in those older villages in the colony which are largely inhabited by these local communities and if so, to what extent it is comparable to the standards that have been reached in the new chaks of the colonisers. Again, within the colony, differences have been observed between chaks in Ganganagar/Padampur area and those at the fag end of the canal system *e.g.*, Raisinghnagar and Anupgarh area. Soil characteristics here are again different as compared to the former area. In these villages, although introduction of irrigation has given greater security to the farmer as compared to his neighbour whose lands are not so favourably located, it has not improved him to the same extent as in the northern villages. These variations are real and might be associated with one or the other of physical and the wider socio-economic factors. Notwithstanding these there is little evidence to the contrary to suggest that these differences have not largely been determined by the single factor, *viz.*, utilisation based on canal irrigation.

10.2 The picture of economic well-being attained by the Project villages is well brought out by the figures in Table No. 4.14. The more advantageous position enjoyed by the colony in the State may also be seen with reference to the selected indicators for the State of Rajasthan given in the Table. Thus, although in terms of availability of land resources and proportion of agricultural population the position of the colony *vis-a-vis* the State is about the same, in respect of the intensity of resource use, production of cash crops and investment in farm equipment the colony is much ahead of the State average.

10.3 In conclusion, mention might be made of the somewhat unique position of sample villages in the non-perennial zone. The indices presented in the above Table convey the impression that the sample villages in the non-perennial zone are more advantageously situated. Indeed, it has been observed that irrigation supplies in these channels have improved in recent years. This is also supported by a comparison of figures of kharif and rabi irrigation in this area. Both in terms of acreage under irrigation and number of waterings, the villages under the command of the Lalgarh channel have attained a comparable position to those enjoying perennial irrigation. The area commanded by the Lalgarh channel lies to the east of the perennial zone and the land here is loamy and fertile. The proximity to Ganganagar has provided this area with good marketing facilities. The chaks under this channel again are old and well established. Cultivation practices are better and greater part of the area is under cultivation of owners themselves. These factors have obviously contributed to better farm conditions in this zone. On the other hand, the land under the command of the Sameja non-perennial is relatively of inferior quality. Orinigally, started as a perennial channel, it was subsequently abandoned. Irrigation on this channel commenced again in 1937 and could not be said to have reached full development. Situated as it is at the tail of the Gang canal at a distance of nearly 133 miles from the head works, the water supply position in this channel is anything but dependable. While the upper outlets have a good command, the lower ones get inadequate supplies. As the minor channels pass through sandy lands, drift sand and sand storms choke the channels which at the tail end have very small cross section.

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CHAPTER V

STRUCTURE OF FARMS

1.0 Agricultural development being a crucial aspect to be studied in relation to an irrigation project, the quantum and value of the total increase in agricultural production which may reasonably be attributed to irrigation need to be assessed. For this, information regarding farm business has to be collected on the basis of study of sample households engaged in farming. A sample survey of farm business was therefore, carried out in selected villages in accordance with the sampling design suggested in Chapter III. A total of 497 farms of which 378 was located in the commanded areas constituted the sample for an intensive enquiry into the various aspects of farm economy. The majority of project farms (354) are under the command of perennial channels and represent conditions of fairly secure irrigation. These units formed the main area of our study. The remaining 24 farms are situated in the non-perennial zone where water supply is limited and irrigation is confined mainly to the Kharif season. Farm is defined in this context as a cultivated holding which is located entirely within the sample village. All holdings which are either fully or partly located outside the villages or *chaks* but which are held by persons residing in these villages, therefore, had to be excluded. Such farms were not many and as the present enquiry was aimed mainly at assessing irrigation effects on the economy of the area, in general and not on the farm households, it was considered that there would be no risk of bias in choosing such a sample.

Enumeration and selection of farms

1.1 As a first step, the enumeration of all the households in the sample villages was carried out. The Census data (1951) could not be used as they were already out of date. Besides new *chaks* had been constituted which were not covered in the 1951 Census. More recent data were available from electrol rools but a preliminary check revealed that the number of resident families was considerably inflated in these lists. A fresh enumeration of households had necessarily to be carried out to obtain a reliable and up-to-date picture of the village. In this listing broad details in regard to occupational structure, size of family, cultivated holding within and outside the selected village, extent of irrigation etc. were also collected. From the information so gathered lists of households were prepared by principal occupational categories as agriculture, labour, industry etc. The cultivator families were further classified by holding groups which conformed to the general distribution of land holdings in the area and from this frame the sample was randomly drawn in accordance with the sampling design. As the study was mainly intended to assess the impact of irrigation on the economy of the tract, no stratification of the farms by the status of the operator was considered necessary. The sample thus covered all interests in land that is those who cultivated their own farms, those who held land as tenants and those who did both.

1.2 In presenting the data on various aspects, the following main groupings of holdings have been adopted : Small farms (0-5 and 5-10 acres), medium farms (10-15 and 15-25 acres) and large farms (over 25 acres). The last group was further divided into two groups of 25-50 and over 50 acres to differentiate the upper starta of medium farmers from the very big operators and owners of land. In the last category (over 50 acres) there are 20 holdings selected from villages with some concentration of large holdings. In view of their special characteristics, they may be looked upon more as case studies rather than a representative sample for particular group or combination of farms. A greater number of farms have an area of about 12.5 acres which is suggestive of the generally larger scale of operation in this region.

Size of farms

2.0 In order to find out whether irrigation influenced the size of holdings, the farms were grouped by number and operated area in specified holding groups and for the main areas of study. From the figures in Table No. 5.0 it is clear that the average holding is of about the same size whether in the project or control area. Not only is this true for all holdings groups taken together but within individual size groups as well. The holdings in the highest group that is, over 50 acres, however, are an exception in that the average area is twice as large in the commanded as in the barani area. Within the irrigated zone, some difference is observed in respect of non-perennial farms, the average holding here being slightly smaller than the perennial farms. The variation, however, is not so important as to merit mention as a special characteristic of the farms under study. It does not appear that greater certainty of water supply in the colony has contributed in any manner to an increase in the size of farm units.

2.1 Considering the different holding groups it would be observed from figures in Table 5.1 that the medium size farms that is, 10-25 acres, are predominant in both the commanded and uncommanded zones. They are 44 per cent of all farms in the commanded area occuping 36 per cent of area as against 56 per cent with 44 per cent of the area in barani zone. In perennial and non-perennial zones also the medium size farms constitute the most significant group. The largest number of farms, however, belong to the size group of 15-25 acres both in project and control area. Next to the medium farms, the larger holdings that is, over 25 acres, constitute in the project a little less than 1/5th of the total number of holdings but cover over half (52 per cent) the cultivated area. An equal area is covered by barani farms in the corresponding groups, although they are relatively more or about one third of the total number of farms.

TABLE NO. 5.0

Number of farms and cultivated area (in acres) by size groups

Zone	0-5		5-10		10-15		15-25		25-50		50 & above		All farms	
	No.	Area	No.	Area	No.	Area	No.	Area	No.	Area	No.	Area	No.	Area
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Perennial	46	150·60 (3·27)	87	695·86 (8·00)	44	571·57 (12·99)	110	1978·44 (17·99)	51	1738·41 (34·09)	16	2038·70 (127·42)	354	7173·58 (20·26)
Non-Perennial ..	6	21·65 (3·61)	1	8·90 (8·90)	4	49·37 (12·34)	7	145·82 (20·83)	5	156·42 (31·28)	1	56·88 (56·88)	24	439·04 (18·29)
Total Irrigated ..	52	172·25 (3·31)	88	704·76 (8·01)	48	620·94 (12·94)	117	2124·26 (18·16)	56	1894·83 (33·84)	17	2095·58 (123·27)	378	7612·62 (20·14)
Barani	3	9·61 (3·20)	10	77·85 (7·79)	8	99·41 (12·43)	59	1013·83 (17·18)	36	1126·64 (31·30)	3	189·70 (63·23)	119	2517·04 (21·15)

Note :—Figures in brackets represent average area of farm.

2.2. The above figures bring out the general similarities in area terms between the commanded and the uncommanded farms. Nevertheless, it is significant that there are more of smaller farms in the canal zone where they constitute 37 per cent of the total with 12 per cent of area as against 11 per cent with about 4 per cent of the area in the uncommanded zone. On the other hand, there are relatively more farms in the higher size group with larger area in the barani zone. Expressing it somewhat differently, an overwhelming proportion of the barani farms that is 89 per cent have an area of over 10 acres each while such farms in the canal zone are only 63 per cent. In the non-perennial zone, however, there are more of medium and larger farms with a higher percentage of cultivated area—a feature of the barani area. From these figures it might be possible to draw the inference that irrigation has facilitated the creation of a large number of smaller holdings. Such inference would not, however, be quite valid because in recent times, a large number of land transfers had taken place mainly to forestall the impending measures of land reforms particularly regarding fixation of ceilings. Although farming is still a family business, land has been split up between the members of the family and registered as such in the official papers. If we considered the total family holdings, the disparity between the project and the barani farms might be much less.

Land tenure

3.0 A system of peasant proprietorship obtains in the Gang canal area in so far as the farms are mainly owned and operated by the farmers themselves. Figures in the Table No. 5.2 indicate that about 62 per cent of farms are under owner-cultivation while another 14 per cent represent predominantly owner-cultivated farms. The precentage of owned farms is higher in the non-perennial zone particularly under Lalgarh channels as also in the Ganganagar Padampur tract in the perennial zone. In terms of cultivated area again, about 70 per cent of the area is under owner-cultivation ('khud Kasht') while the remaining is about equally distributed between the category of purely tenant-cultivated holdings and those partly owned. It is noteworthy that with the exception of farms in the lowest and highest size groups, the extent of owned farms increases with the increase in the area of the farm. No such feature, however, is indicated in the non-perennial zone. Considering farms in the lowest size group, over half of them (or 54 per cent) were observed to be under tenant cultivation. It was noticed that in a good number of cases, these farms were rent-free land given to village functionaries who found it convenient to lease these holdings to others generally on share-crop basis.

3.1 In the barani area, the tenancy pattern is sharply different. Here land is held on lease from the State at fixed cash rent. In percentage terms, as many farms are tenant-cultivated in this area as are under owner-cultivation in the commanded area. The only exception is the village Thakharanwali in Ganganagar where farms are mainly owned. The above difference in the

TABLE NO. 5.1

Percentage distribution of sample farms and area by size groups

Size Group (in acres)	Perennial		Non-Perennial		Total irrigated		Barani	
	Farms	Area	Farms	Area	Farms	Area	Farms	Area
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
0-5	12·99	2·10	25·00	4·93	13·76	2·26	2·52	0·38
5-10	24·58	9·70	4·17	2·03	23·28	9·26	8·41	3·09
10-15	12·43	7·97	16·66	11·24	12·70	8·16	6·72	3·95
15-25	31·07	27·58	29·17	33·21	30·95	27·90	49·58	40·28
25-50	14·41	24·23	20·83	35·63	14·81	24·89	30·25	44·76
50 & above	4·52	28·42	4·17	12·96	4·50	27·53	2·52	7·54
TOTAL	100	100	100	100	100	100	100	100

TABLE No. 5.2

Distribution of owned and rented farms

Size Group	IRRIGATED							
	PERENNIAL				NON PERENNIAL			
	Total farms	Fully owned	Fully rented	Partly owned/ rented	Total farms	Fully owned	Fully rented	Partly owned/ rented
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
0-5	46	18	28	—	6	6	—	—
	(100·00)	(39·13)	(60·87)	—	(100·00)	(100·00)	—	—
5-10	87	47	26	14	1	1	—	—
	(100·00)	(54·02)	(29·89)	(16·09)	(100·00)	(100·00)	—	—
10-15	44	23	11	10	4	2	—	2
	(100·00)	(52·27)	(25·00)	(22·73)	(100·00)	(50·00)	—	(50·00)
15-25	110	77	19	14	7	5	1	1
	(100·00)	(70·00)	(17·27)	(12·73)	(100·00)	(71·42)	(14.29)	(14·29)
25-50	51	41	7	3	5	5	—	—
	(100·00)	(80·39)	(13·73)	(5·88)	(100·00)	(100·00)	—	—
50 and above	16	9	—	7	1	1	—	—
	(100·00)	(56·25)		(43·75)	(100·00)	(100·00)	—	—
All Farms	354	215	91	48	24	20	1	3
	(100·00)	(60·73)	(25·71)	(13·56)	(100·00)	(83·33)	(4·17)	(12·50)

TABLE NO. 5.2 (*Contd.*)

Size Group	TOTAL IRRIGATED				BARANI			
	Total farms	Fully owned	Fully rented	Partly owned/ rented	Total farms	Fully owned	Fully rented	Partly owned/ rented
(1)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
0-5	52 (100·00)	24 (46·15)	28 (53·85)	—	3 (100·00)	2 (066·67)	1 (33·33)	—
5-10	88 (100·00)	48 (54·54)	26 (29·55)	14 (15·91)	10 (100·00)	4 (40·00)	6 (60·00)	—
10-15	48 (100·00)	25 (52·08)	11 (22·92)	12 (25·00)	8 (100·00)	3 (37·50)	5 (62·50)	—
15-20	117 (100·00)	82 (70·09)	20 (17·09)	15 (12·82)	59 (100·00)	12 (20·34)	46 (77·97)	1 (1·69)
25-50	56 (100·00)	40 (82·14)	7 (12·50)	3 (5·36)	36 (100·00)	15 (41·67)	16 (44·44)	5 (13·89)
50 and above	17 (100·00)	10 (58·82)	—	7 (41·18)	3 (100·00)	1 (33·33)	1 (33·33)	1 (33·34)
All Farms	378 (100·00)	235 (62·17)	92 (24·34)	51 (13·59)	119 (100·00)	37 (31·09)	75 (63·03)	7 (5·88)

NOTE :—Figures in brackets represent percentages to total farms in Cols. (2) & (6); (10) & (14)

tenancy systems is significant from the point of view of assessing the effects of irrigation and suggests need for caution in generalising beyond a point. The figures, however, do seem to indicate that availability of irrigation has considerably helped to develop land-market and promoted a desire for ownership of land.

3.2 Considering only the holdings which are fully under tenant-cultivation, it would be seen that while in the commanded area such farms are only about 1/4 they are considerably more (about 63 per cent) in the barani area (Table No. 5.2). There is marked preference for crop-sharing or 'Bataidar' system in the commanded area (Tables 5.3 & 5.4). Thus about 28 per cent of the farms covering an area of 38 per cent are under the 'bataidar' system (Table No. 5.4). While this is the overall average, there are more farms with greater area relatively under this system in Ganganagar-Padampur tract as compared to Ghaggar tract in Anupgarh. In the former area again more such farms have been reported in the higher size groups, an evidence to some extent of absentee land-lordism in the neighbourhood of Ganganagar. These in the Anupgarh area, however, occur equally in various size groups. Where the yield from crop is not only assured but under normal conditions also considerably higher than in the barani area, it is profitable to enter into such agreements for sharing the crop. Next to the barani farms and equally important are the lands leased annually from the State. Such holdings constitute about 27 per cent of project farms with 1/4th of the cultivated area. Evidently greater number of them are located in lower size groups. Further, this category of farms is largely found in Anupgarh area where colonisation is still in progress. Besides these two categories, private leases or subleases are comparatively few, being less than 10 per cent. The last category of farms included under 'others' represent for the most part mixed farm as also those which are rent free. In the barani area on the other hand, most of the land (92 per cent of farms with 90 per cent of area) is held on lease from the Government paying fixed cash rent.

3.3 Land rent which is an important index of agricultural prosperity is seen to vary markedly between commanded and uncommanded farms as also in each area between different tenancy systems. Prevailing rents on irrigated farms are considerably higher in comparison to rents charged for fairly similar class of land in the barani area. On land held from the Government, the average rent is reported as Re. 1 per acre in the Barani zone while in the commanded villages it is around Rs. 6 (Table No. 5.5). The rent differentials are very much marked in respect of private leases. The rent increase of over ten times per acre of irrigated area is not uncommon. Among other things, this is suggestive of the more advantageous position enjoyed by private land owners who are able to take the full benefit from increased farm productivity. On the contrary, rent on public land is small and bears no relation to present economic conditions of the farm.

TABLE NO. 5.3

Distribution of rented farms by principal categories

Zone	Cash rent				Kind rent		Miscellaneous		Total	
	State		Private							
	No.	Area	No.	Area	No.	Area	No.	Area	No.	Area
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Perennial	25 (27·4)	245·01 (25·4)	9 (9 ·9)	86·56 (9·0)	26 (28·6)	377·96 (39·2)	31 (34·1)	253·84 (26·4)	391 (100·)	963·37 (100·0)
Non-Perennial			1 (100·0)	22·81 (100·0)	—	—	—	—	1 (100·0)	22·81 (100·0)
Total Irrigated	25 (27·2)	245·01 (24·8)	10 (10·8)	109·37 (11·1)	26 (28·3)	377·96 (38·3)	33·31 (33·7)	253·84 (25·8)	92 (100·0)	986·18 (100·0)
Barani	69 (92·0)	1285·81 (90·0)	1 (1·3)	6·25 (0·5)	2 (2·7)	18·74 (1·3)	3 (4·0)	117·18 (8·2)	75 (100·0)	1427·68 (100·0)

NOTE :—Figures in brackets represent percentage to related total in cols. 10 & 11.

TABLE NO. 5.4

Percentage distribution of rented farms by principal categories and farm

Size Group	IRRIGATED					BARANI				
	Cash rent		Kind rent	Others	Total	Cash rent		Kind rent	Others	Total
	State	Private				State	Private			
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
0-5										
No.	7·1	3·6	14·3	75·0	100·0	—	—	100·0	—	100·0
Area	9·2	3·7	8·0	79·1	100·0	—	—	100·0	—	100·0
5-1										
No.	50·0	19·2	19·2	11·6	100·0	83·3	16·7	—	—	100·0
Area	49·4	20·0	19·2	11·4	100·0	84·7	15·3	—	—	100·0
10-15										
No.	45·5	9·1	36·3	9·1	100·0	100·0	—	—	—	100·0
Area	44·3	8·7	37·5	9·5	100·0	100·0	—	—	—	100·0
15-25										
No.	35·0	15·0	45·0	15·0	100·0	95·6	—	2·2	2·2	100·0
Area	23·3	16·1	45·1	15·5	100·0	94·9		2·0	3·1	100·0
25-50								—		
No.	—	—	57·1	42·9	100·0	93·8	—		6·2	100·0
Area	—	—	61·0	39·0	100·0	93·7	—	—	6·3	100·0
50 and above										
No.	—	—	—	—	—	—	—	—	100·0	100·0
Area	—	—	—	—	—	—	—	—	100·0	100·0
Total										
No.	27·2	10·8	28·3	33·7	100·0	92·0	1·3	2·7	4·0	100·00
Area	24·8	11·1	38·3	25·8	100·0	90·0	0·5	1·3	8·2	100·00

TABLE NO. 5.5

Average rent on land under principal categories of lease

(Rs. per acre)

Particulars	Irrigated	Barani
1. State leases	6·0	1·0
2. Private		
(*a*) Cash	78·0	5·0
(*b*) Kind	87·0	39·0

3.4 The impact of irrigation on land rents may be seen with reference to figures of rent paid in kind. On an average, such rent is over twice as large on irrigated farms as in the barani farms. Between different holdings the comparative position of rents may vary. It is, however, not possible to comment further in this respect, in view of the rather limited number of farms under 'Batai' rent in the barani zone. It was observed that the small holdings paid higher rents. A few cases were reported where the gross value of share of crop was over Rs. 200 per acre in respect of smaller holdings.

3.5. While rents may vary on different farms they are evidently dependent on such factors as soil, water supply, locational factors etc. Tradition also plays an important part in determining the share of produce between the landowner and the tenant. In the older villages, for instance, the Batai is lower while in the case of more recent settlements, it is generally higher. The common practice is that the produce is shared equally by the tenant and the owner, with the owner providing half of expenses on seeds. fertilisers, crop and water rates including cesses. There are, however, exceptions to this practice and the general division of produce between landlord and tenant may vary to a greater or lesser extent.

Area under kharif and rabi

4.0 A break-up of the cultivated area by the principal crop seasons suggests the higher acreage under Rabi crops in both the commanded and uncommanded farms, although in the latter rabi cultivation is significantly higher or 73 per cent of cropped area as against 58 per cent in the project area. (Table No. 5.6). The higher acreage under rabi in the barani area is to some extent explained by the more favourable September rains in 1958-59 which was considerably in excess of rainfall in the past few years. In the project area, the general distribution of kharif and rabi cropping is 42 per cent and 58 per cent respectively. The above distribution is comparable to conditions of Perennial irrigation although even here, rabi acreage is seen to be somewhat higher in the chagger tract in Anupgarh. In the non-perennial zone except under the Sameja, the acreage under kharif and rabi is more equally distributed. In the latter farms rabi area is considerably higher (83 per cent), which is suggestive of near barani conditions. Under kharif, we have included an annual crop like sugar-cane which is usually planted in March-April. Without this crop, however, the rabi acreage would increase further in the canal area. Even so the difference is not significant and the greater dependence on one crop in the barani area is only too apparent in these figures.

TABLE No. 5.6

Area under Kharif and Rabi cultivation

(In acres)

Size Group	Perennial		Non-Perennial		Total Irrigated		Barani	
	Kharif	Rabi	Kharif	Rabi	Kharif	Rabi	Kharif	Rabi
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
0-5	67·09 (40·7)	97·57 (59·3)	17·59 (66·0)	9·06 (34·0)	84·68 (44·3)	106·63 (55·7)	— —	9·61 (100·0)
5—10	276·16 (41·1)	395·86 (58·9)	5·62 (52·9)	5·00 (47·1)	281·78 (41·3)	400·86 (58·7)	6·86 (8·1)	77·85 (91·9)
10—15	214·79 (39·8)	325·32 (60·2)	24·37 (46·6)	27·97 (53·4)	239·16 (40·4)	353·29 (59·6)	34·37 (29·4)	82·65 (70·6)
15—25	729·68 (39·6)	1112·34 (60·4)	78·02 (49·7)	79·00 (50·3)	807·70 (40·4)	1191·34 (59·6)	372·60 (33·0)	757·86 (67·0)
25—50	704·75 (43·7)	909·46 (56·3)	71·09 (41·8)	98·83 (58·2)	775·84 (43·5)	1008·29 (56·5)	254·71 (23·6)	825·39 (76·4)
50 & above	722·98 (41·6)	1013·16 (58·4)	29·38 (65·3)	15·62 (34·7)	752·36 (42·2)	1028·78 (57·8)	16·87 (11·1)	135·33 (88·9)
TOTAL	2715·45 (41·3)	3853·71 (58·7)	226·07 (49·0)	235·48 (51·0)	2941·52 (41·8)	4089·19 (58·2)	685·41 (26·6)	1888·69 (73·4)

NOTE : Figures in brackets represent percentage to total cropped area.

4.1 Between various farm groups, some differences are noticeable in kharif and rabi cultivation. For instance in the non-perennial zone, percentage of rabi cultivation increases with the area of the farm that is from about 34 per cent of annual area on small farms to about 58 per cent on large farms with area varying between 25 to 50 acres. Farms in the next higher group, however, have recorded a lower acreage, one nearer to that of small farms. Even in the perennial zone, larger farms have higher acreage under kharif due perhaps to more extensive cultivation of sugarcane and cotton crops.

5.0 It is not so much the general division of area under kharif and rabi crops as the acreages under individual crops and changes in cropping pattern which are significant from the point of view of study of farm business. Table No. 5.7 gives the details of area under crops for various farm groups and zones of study. The same information is given in table No. 5.8 which expresses crop acreage as per cent of total cropped area.

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TABLE NO. 5.7

Area under crops and percentage distribution (In acres)

	Perennial						
	0—5	5—10	10—15	15—25	25—50	50 & above	Total
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Kharif							
Sugarcane	2·96	13·95	8·04	42·74	37·70	68·35	173·74
	(1·8)	(2·1)	(1·5)	(2·3)	(2·3)	(3·9)	(2·6)
Cotton	36·32	141·25	120·47	376·60	416·04	377·85	1468·62
	(22·1)	(21·0)	(22·3)	(20·4)	(25·8)	(21·8)	(22·4)
Rice	1·88	12·80	6·89	43·42	17·52	15·00	97·51
	(1·1)	(1·9)	(1·3)	(2·4)	(1·1)	(0·8)	(1·5)
Fodder Crops	19·82	97·07	70·69	233·77	200·77	228·90	851·02
	(12·0)	(14·4)	(13·1)	(12·7)	(12·4)	(13·2)	(12·9)
Others	6·11	11·09	8·70	33·06	32·72	32·88	124·56
	(3·7)	(1·7)	(1·6)	(1·8)	(2·0)	(1·9)	(1·9)
TOTAL	67·09	276·16	214·79	729·68	704·75	722·98	2715·45
	(40·7)	(41·1)	(39·8)	(39·6)	(43·6)	(41·6)	(41·3)
Rabi							
Wheat	50·82	210·74	173·60	584·75	484·75	428·58	1932·50
	(30·8)	(31·4)	(32·1)	(31·8)	(30·0)	(24·7)	(29·4)
Gram	10·15	59·20	47·75	186·68	181·91	204·18	689·87
	(6·2)	(8·8)	(8·8)	(10·1)	(11·3)	(11·8)	(10·5)
Mixed Crops	11·32	40·69	22·58	104·39	117·47	182·62	479·57
	(7·2)	(6·1)	(4·2)	(5·7)	(7·3)	(10·5)	(7·3)
Oil seeds	12·62	48·45	50·73	147·79	74·01	101·61	435·21
	(7·7)	(7·2)	(9·4)	(8·0)	(4·6)	(5·9)	(6·7)
Fodder crops	5·76	80·61	22·09	76·11	48·00	27·91	210·38
	(3·5)	(4·5)	(4·1)	(4·1)	(3·0)	(1·6)	(3·2)
Others	6·40	6·27	8·57	12·62	4·06	68·26	106·18
	(3· 9)	(0·9)	(1·6)	(0·7)	(0·2)	(3·9)	(1·6)
TOTAL	97·58	395·86	325·32	1112·84	909·46	1013·16	3853·71
	(59·3)	(58·9)	(60·2)	(60·4)	(56·4)	(58·4)	(58·7)
Total (Kharif & Rabi)	164·66	672·02	540·11	1842·02	1614·12	1736·14	6569·16
	(100·0)	(100·0)	(100·0)	(100·0)	(100·0)	(100·0)	(100·0)

Note : Figures in brackets represent percentages to total cropped area under kharif and Rabi.

Non-Perennial						
0—5	5—10	10—15	15—25	25—50	50 and above	Total
(8)	(9)	(10)	(11)	(12)	(13)	(14)
—	—	—	—	—	—	—
—	—	—	—	—	—	—
8·75	3·75	13·44	51·15	47·01	15·00	139·10
(32·9)	(35·3)	(25·7)	(32·6)	(27·7)	(33·3)	(30·2)
—	—	—	—	—	—	—
—	—	—	—	—	—	—
8·84	1·87	10·31	24·84	20·47	14·38	80·71
(33·1)	(17·6)	(19·7)	(15·8)	(12·0)	(32·0)	(17·5)
—	—	0·62	2·03	3·61	—	6·26
—	—	(1·2)	(1·3)	(2·1)	—	(1·3)
17·59	5·62	24·37	78·02	71·09	29·38	226·07
(66·0)	(52·9)	(46·6)	(49·7)	(41·8)	(65·3)	(49·0)
2·82	3·75	5·62	30·45	13·02	12·50	68·16
(10·6)	(35·4)	(10·7)	(19·4)	(7·7)	(27·8)	(14·8)
3·81	0·63	18·76	34·94	44·09	1·56	103·79
(14·3)	(5·9)	(35·8)	(22·3)	(25·9)	(3·5)	(22·5)
—	—	3·59	4·37	39·43	—	47·39
—	—	(6·9)	(2·8)	(23·2)	—	(10·3)
1·87	—	—	6·12	—	1·25	9·24
(7·0)	—	—	(3·9)	—	(2·8)	(2·0)
0·56	—	—	3·12	0·79	0·31	4·78
(2·1)	—	—	(1·9)	(0·5)	(0·6)	(1·0)
—	0·62	—	—	1·50	—	2·12
—	(5·8)	—	—	(0·9)	—	(0·4)
9·06	5·00	27·97	79·00	98·83	15·62	235·48
(34·0)	(47·1)	(53·4)	(50·3)	(56·2)	(34·7)	(51·0)
26·65	10·62	52·34	157·02	169·92	45·00	461·55
(100·0)	(100·0)	(100·0)	(100·1)	(100·1)	(100·1)	(100·1)

TABLE NO. 5.7 (*Contd.*)

Crop pattern in sample farms

(Overall figures for Irrigated and Barani)

Zone	Irrigated						Total
	0—5	5—10	10—15	15—25	25—50	50 & above	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Sugarcane	2·96	13·95	8·04	42·74	37·70	68·35	173·74
	(1·5)	(2·1)	(1·3)	(2·1)	(2·1)	(3·8)	(2·5)
Cotton	45·07	145·00	133·91	427·84	463·05	392·85	1607·72
	(23·5)	(21·2)	(22·6)	(21·4)	(26·0)	(22·1)	(22·9)
Rice	1·88	12·80	6·89	43·42	17·52	15·00	97·51
	(1·0)	(1·9)	(1·1)	(2·2)	(1·0)	(0·8)	(1·4)
Fodder Crops	28·66	98·94	81·00	258·61	221·24	243·28	931·73
	(15·0)	(14·5)	(13·7)	(12·9)	(12·4)	(13·7)	(13·2)
Others	6·11	11·09	9·32	35·09	36·33	32·88	130·82
	(8·2)	(1·6)	(1·6)	(1·8)	(2·0)	(1·8)	(1·8)
TOTAL	84·68	281·78	239·16	807·70	775·84	752·36	2941·52
	(44·2)	(41·3)	(40·3)	(40·4)	(43·5)	(42·2)	(41·8)
Rabi							
Wheat	53·64	214·49	179·22	615·20	497·03	441·08	2000·66
	(28·00)	(31·4)	(30·3)	(30·8)	(27·9)	(24·8)	(28·5)
Gram	13·96	59·83	66·51	221·62	226·00	205·74	793·66
	(7·3)	(8·8)	(11·2)	(11·1)	(12·7)	(11·5)	(11·3)
Mixed Crops	11·82	40·69	26·17	108·76	156·90	182·62	526·96
	(6·2)	(5·9)	(4·4)	(5·4)	(8·8)	(10·3)	(7·5)
Oilseeds	14·49	48·45	50·73	153·91	74·01	102·86	444·45
	(7·6)	(7·1)	(8·6)	(7·7)	(4·1)	(5·8)	(6·3)
Fodder Crops	6·32	30·51	22·09	79·23	48·79	28·22	215·16
	(8·3)	(4·5)	(3·7)	(4·0)	(2·7)	(1·6)	(3·1)
Others	6·40	6·89	8·57	12·62	5·56	68·26	108·30
	(3·4)	(1·0)	(1·5)	(0·6)	(0·3)	(3·8)	(1·5)
TOTAL	106·63	400·86	353·29	1191·34	1008·29	1028·78	4089·19
	(55·8)	(58·7)	(59·7)	(59·6)	(56·5)	(57·8)	(58·2)
GRAND TOTAL (Kharif & Rabi)	191·31 (100·00)	682·64 (100·00)	592·45 (100·0)	1999·04 (100·0)	1784.13 (100·0)	1781·14 (100·0)	7030·71 (100 0)

Figures in brackets represent percentages to total cropped area in each size group under kharif and Rabi.

TABLE NO. 5.7 (*Concld.*)

Barani						Total
0–5	5–10	10–15	15–25	25–50	50 & above	
(8)	(9)	(10)	(11)	(12)	(13)	(14)
—	—	—	—	—	—	—
—	—	—	—	—	—	—
—	—	—	—	—	—	—
—	—	—	—	—	—	—
—	—	—	—	—	—	—
—	—	—	—	—	—	—
—	2·49	24·37	256·58	189·71	10·61	483·77
—	(2·9)	(20·8)	(22·7)	(17·6)	(7·0)	(18·8)
—	4·37	10·00	116·02	65·00	6·25	201·64
—	(5·2)	(8·6)	(10·3)	(6·0)	(4·1)	(7·8)
—	6·86	34·37	372·60	254·71	16·87	685·41
—	(8·1)	(29·4)	(33·0)	(23·6)	(11·1)	(26·6)
6·49	13·50	16·87	101·87	188·69	31·26	358·68
(67·5)	(15·9)	(14·4)	(9·0)	(17·5)	(20·5)	(13·9)
—	15·62	21·25	105·66	167·04	25·01	334·58
—	(18·4)	(18·2)	(9·3)	(15·4)	(16·4)	(13·0)
8·12	38·11	10·78	240·60	192·76	25·00	510·37
(32·5)	(45·0)	(9·2)	(21·3)	(17·8)	(16·4)	(19·8)
—	5·00	33·75	226·60	196·25	44·69	506·29
—	(5·9)	(28·8)	(20·0)	(18·2)	(29·4)	(19·7)
—	—	—	—	—	—	—
—	—	—	—	—	—	—
—	5·62	—	83·12	80·65	9·37	178·77
—	(6·7)	—	(7·4)	(7·5)	(6·2)	(7·0)
9·61	77·85	82·65	757·86	825·39	135·53	1888·69
(100·01)	(91·9)	(70·6)	(67·0)	(76·4)	(88·9)	(73·4)
9.61	84·71	117·02	1130·46	1080·10	152·20	2574·10
(100·0)	(100·0)	(100·0)	(100·0)	(100·0)	(100·0)	(100·0)

TABLE No. 5.8

Area under crops

	Irrigated		Barani	
	Area (acres)	Per cent	Area (acres)	Per cent
(1)	(2)	(3)	(4)	(5)
Kharif				
Sugarcane	173·74	2·5	—	—
Cotton	1607·72	22·9	—	—
Rice	97·51	1·4	—	..
Fodder	931·73	13·2	483·77	18·8
Others	130·82	1·8	201·64	7·8
SUB-TOTAL ..	2941·52	41·8	685·41	26·6
Rabi				
Wheat	2000·66	28·5	358·68	13·9
Gram	793·66	11·3	334·58	13·0
Mixed Crops	526·96	7·5	510·37	19·8
Oil-seeds	444·45	6·3	506·29	19·7
Fodder	215·16	3·1	—	—
Others	108·30	1·5	178·77	7·0
SUB-TOTAL ..	4089·19	58·2	1888·69	73·4
TOTAL	7030·71	100·00	2574·10	100·00

5.1 In the entire commanded area, the principal kharif crops are cotton (23 per cent), followed by fodder (13.2 per cent) while in rabi wheat is extensively grown accounting for about 29 per cent of area followed by gram (11 per cent). The practice of mixed cropping is prevalent in this area although not so extensively as in the barani villages. The most popular mixtures are Gochini (wheat and gram) and Bejar (wheat and barley). The area under mixed crops is about 8 per cent of the total cropped area. As much as one half of the total cropped area is under food crops in the irrigated zone. Next in importance are the fodder crops which are extensively grown in the irrigated villages where all cattle are stall-fed. The most important feed crops are jowar and gowara in the kharif while in rabi berseem is raised. A greater part of this cultivation is done in the kharif and usually after taking a heavy crop like sugarcane and cotton. Sugarcane is cultivated mainly under perennial irrigation to the extent of about 3 per cent. This is an intensive crop, in that assured and continuous water supply is needed. The absence of this crop in the non-perennial zone may thus be attributed entirely to the fact of the limited and equally insecure water supply in this zone. Within the perennial zone again, although total area under this crop is higher in the Ganganagar-Padampur tract, relatively greater proportion of the farm area is put under this crop in Anupgarh. This feature is also true of farms in various size groups. Apart from these crops, cultivation of rice is limited to the Ghaggar tract suitable for paddy cultivation. This crop which is entirely marketed accounts for about 1.4 per cent of the total area or 3.6 per cent of the acreage under kharif.

5.2. Within the irrigated zone, some differences are observed between perennial and non-perennial farms. For instance, in the latter area, the cultivation of cotton and fodder crops in the kharif and grams in the rabi is higher. To a lesser extent, the area under mixed crops is also slightly larger in the non-perennial zone. The wheat acreage however, is considerably less or about one half of the comparable area in the perennial zone. Considering the principal crops, it is observed that there acreages do not disclose any consistent trend with the increase in the area of holding. Whether for kharif or rabi crops, the percentage area remains substantially the same between different farm groups.

5.3 In contrast to the crop pattern in irrigated chaks, there is greater dependence on rabi crops in the uncommanded villages and kharif cultivation is restricted to about 27 per cent of the area. A greater part of this again is under fodder crops like jowar and gowara. Cultivation of such crops as sugarcane, cotton and rice, for obvious reasons, is impossible in this area. In the winter months, however, farming is more extensive. As would be seen from the figures, about a 1/5th of the area is under oil-seeds and other crops respectively while wheat and gram account for about 13 per cent each. While no consistent relation between crop acreages and size of farm might be seen, it is noteworthy that farms in the lowest category that is 0.5 acres, grow almost exclusively food crops mainly wheat, either singly or in combination with other crops. On the other hand, oil-seeds are more extensively raised on larger holdings. This incidentally is the principal cash crop in this area. A greater area under mixed cropping is again an insurance against possible crop failure. It would be observed that the area under food crops is nearly 74 per cent and in this respect is comparable to project farms. Between different villages crop pattern varies somewhat and is reminiscent of conditions before the advent of the canal. As the Assessment Report observes, in the pre-canal period mainly coarse crops such as bajra, moth and til were grown. An earlier reference (Imperial Gazetteer of India 1908) describing the conditions in the present tract observes again that in the Central sandy tract, there was practically only one harvest, that is the kharif or autumn crop; the principal crops were bajra, moth and jowar and cultivation of wheat, barley and gram was confined mainly to the Suratgarh Nizamath.

5.4 On the whole, it would appear that the more favourable September rains, in the year of enquiry, 1958-59, have increased the acreage under rabi unusually. Ultimately however, the division of area between these two groups is determined more with reference to the traditional cropping practices, availability of water supply and other physical and extraneous factors. The scale of operations as such does not seem to have any impact on the allocation of crops or to induce a marked preference for one or the other. A fact of great significance emerging from this analysis is that with adequate and assured water supply, more crops are raised and acreage increased or as much area is put under the first as under the second crop. In the absence of such facilities or where the water supply is insecure (as is the case of farms under Sameja) the cultivator is forced to put his faith more on one crop.

Intensity of cropping

6.0 It has already been mentioned that with adequate and assured water supply more crops are raised and cultivation extended in both the seasons. Even so, odd as it may seem, there is more of intensive farming in the barani area because double cropping is greater here (Table No. 5.9). In percentage terms both the sown area and that under double cropping are less in the project area. The percentage is, however, higher in the non-perennial zone due mainly to the growing of quick maturing crops which increase the total cropped acreage considerably.

TABLE NO. 5.9

Percentage distribution of sown area and double cropped area

Size Group	IRRIGATED						BARANI	
	Perennial		Non-Perennial		Total			
	Net area sown	Double cropped area	Net area sown	Double cropped area	Net area sown	Double cropped area	Net area sown	Double cropped area
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
0—5	95·1	14·1	97·1	26·0	95·4	15·6	100·0	—
5—10	87·5	9·1	98·3	21·0	87·6	9·3	100·0	8·8
10—15	85·4	9·1	96·5	9·5	86·3	9·2	99·7	18·0
15—25	92·8	7·2	91·8	15·9	86·8	7·3	94·1	17·4
25—50	87·6	5·2	99·6	9·0	88·6	5·5	89·6	6·3
50 & above ..	82·74	2·4	74·7	4·4	82·5	2·5	80·2	—
All farms ..	85·9	5·7	83·3	11·8	86·3	5·9	91·3	10·8

6.1 Looking at it from a somewhat different angle, on the basis of, the figures of percentage crop intensity which relates total cropped area to the cultivated area, larger area is sown with crops in the barani zone or 102 per cent as against 92 per cent in the commanded area (Table No. 5.10). Further, crop intensity is higher in the non-perennial zone while within the perennial zone, it is considerably lower in Ghaggar tract. A feature generally observed in the irrigated area, is that crop intensity is the highest on small farms while on larger holdings it is much less. In the barani area, on the other hand, intensity is observed to be generally higher and is less only on very large farms. The anomaly that above figures suggest may be explained mainly with reference to the larger fallow area in the commanded zone which is due to both the restricted water supply (since permissible area is less than the holding) and the cropping practices. On the contrary, in the barani area such a practice is not necessary and with favourable rainfall every inch of land is tilled. Thus while about 13 per cent of the cultivated area is accounted for by fallows, in the project zone the corresponding area is about 9 per cent in the barani zone. It may be added that even this largely represents permanent fallows or otherwise uncultivable land.

TABLE No. 5.10

Crop Intensity

Size Groups	Perennial	Non-perennial	Total	Barani
(1)	(2)	(3)	(4)	(5)
0—5	109	123	111	100
5—10	97	119	97	109
10—15	94	106	95	11
15—25	93	107	94	112
25—50	93	109	94	96
50 & above	85	79	85	80
All farms	92	105	92	102

6.2 The foregoing consideration of crop intensity adds upto an impression that conditions of farming are favourable in the barani area. A further enquiry into the extent of matured area suggests a different conclusion. For instance, in the year of enquiry which was an exceptionally favourable year for the Barani area 8 per cent of the crop area was reported as "Kharaba" in this zone. (Table No. 5.11). This percentage, however, varies to a greater or lesser extent as between different villages; for instance, the crop failure was the highest in the holdings in Anupgarh where as earlier observed, the percentage intensity was also higher. The percentage mature area on the other hand was far greater in the irrigated zone. Taking account of the fact of maturity of cropping, the intensity figures would be much lower in the barani area.

TABLE No. 5.11

Area sown and matured

(In acres)

Size Group	Perennial		Non-perennial		Total (Irrigated)		Barani	
	sown	harvested	sown	harvested	sown	harvested	sown	harvested
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
0—5	164·66	159·16 (96·7)	26·65	26·65 (100)	191·31	185·81 (97·1)	9·61	9·61 (100)
5—10	672·02	664·57 (98·9)	10·62	8·75 (82·4)	682·64	673·32 (98·6)	84·71	84·09 (99·3)
10—15	540·11	525·09 (97·2)	52·34	51·06 (97·6)	592·45	576·15 (97·2)	117·02	104·52 (89·3)
15—25	1842·02	1833·55 (99·5)	157·02	157·02 (100·)	1999·04	1990·57 (99·6)	1130·46	1022·97 (90·2)
25—50	1614·21	1516·13 (93·9)	169·92	169·92 (100·0)	1784·13	1686·05 (94·5)	1080·18	983 85 (91·1)
50 and above	1736·14	1732·08 (99·8)	45·00	45·00 (100·0)	1781·14	1777·08 (99·8)	152·20	152·20 (100·0)
TOTAL	6569·16	6430·58 (97·9)	461·55	458·40 (99·3)	7030·71	6888·98 (98·0)	2574·10	2357·24 (91·5)

NOTE. Figures in brackets represent percentage harvested area to sown area.

Extent of unirrigated area

7.0 Canal irrigation is the only source of water supply in the region and a few wells that exist provide mainly the drinking water supply. While utilisation of irrigation facilities is fairly excess of permissible limits, our data suggests that about 8 per cent of the cropped area has not been irrigated during the year of enquiry (Table 5.12). This is largely farm land that has not received even a single watering although it is likely that this figure also includes a good proportion of land which is uncommanded. It has also been observed that the percentage of unirrigated area is higher in the non-perennial zone where it accounts for 12 per cent. The extent of unirrigated area is again higher during Rabi due perhaps to the fact that irrigation requirements are less when sufficient moisture is retained in the soil especially after the intensive watering in Kharif. The extent of unirrigated area again is seen to vary between different size groups. On the whole, there is reason to believe that irrigation is rapidly expanding in the colony. In any one year, the extent of commanded area which has not received irrigation or which otherwise might not have been cultivated or left fallow is determined by several factors and need not necessarily be an index of the irregularity of water supply. Water is often diverted from one field to another for greater intensive cropping. The higher percentage of unirrigated area in the non-perennial zone would seem to confirm the view of uncertain and limited supplies in this zone. It is possible that there is not enough water to go round the everincreasing demand for it. That there is some scarcity, which is particularly felt in certain periods and for certain operations is also confirmed by the replies of farmers gathered in a supplemental opinion survey to assess utilisation aspects in the area. Elsewhere in the report, this aspect has been dealt with in some detail.

Farming Communities

8.0 An understanding of the nature of farming communities and agricultural skills available might explain the differences in farm economy and variations in production especially where other conditions are similar. Reference was made earlier to the settlers from the Punjab who brought with them knowledge of techniques of irrigated farming and skills in the adoption of new crops, factors which have largely characterised the rural economy here. It would be seen that in the irrigated sample, Sikh peasants (both Jats and Kambohs) possess about 46 per cent of the total farms. (Table No. 5.13). These are mostly new settlers who had purchased greater part of the colony lands under perennial irrigation. Bishnois who are earlier 'Abadkars' with about 12 per cent of farms come next while the backward classes that is, Harijans and Bawaris who were following pastoral occupations possess about 18 per cent of the holdings. By and large, however, the last category consists of landless labourers. It is noteworthy that although Bishnois, Rajputs and other local or non-migrant peasants together constitute a significant proportion of the population, in terms of area, they own

TABLE No. 5.12

Cropped area and percentage area unirrigated

Size Group	Perennial		Non-Perennial		Total	
	Cropped area	Area unirrigated	Cropped Area	Area unirrigated	Cropped area	Area unirrigated
(1)	(2)	(3)	(4)	(5)	(6)	(7)
0—5	164·66	4·18 (2·54)	26·65	—	191·31	4·18 (2·18)
5—10	672·02	44·29 (6·59)	10·62	—	682·64	44·29 (6·49)
10—15	540·11	48·75 (9·01)	52·34	11·41 (21·80)	592·45	60·16 (10·14)
15—25	1842·02	95·01 (5·16)	157·02	9·49 (6·04)	1999·04	104·50 (5·23
25—50	1614·21	70·78 (4·38)	169·92	35·59 (20·94)	1784·13	106·37 (5·96)
50 and above	1736·14	230·07 (13·25)	45·00	—	1781·14	230·07 (12·92)
All Farms	6569·16	493·08 (7·50)	461·55	56·49 (12·24)	7030·71	549·57 (7·81)

NOTE. Figures in brackets are percentages to total cropped area.

much less land. Some differences are seen between different villages as also between farm levels. For instance, Sikhs are in greater number in the perennial zone and the average holding is also larger. On the other hand, Jats have more land in the chaks under non-perennial channels. In the barani area, however, the Harijans and Bawaris, the latter mainly sheep-breeders, predominate. Their number is particularly significant in the Anupgarh villages. With comparatively recent skills in agriculture, their holdings are also smaller. On the other hand, the more progressive farmers have larger holdings. The jats who have traditional skills in farming are mainly limited to the village Thakaranwali.

TABLE NO. 5.13

Percentage distribution of farm families by principal Communities

Community (1)	Irrigated (2)	Barani (3)
Jats (Sikh)	33·1	4·2
Kambohs	12·4	—
Jats	7·7	15·9
Bishnois	11·6	5·9
Rajputs	5·8	1·7
Harijans and Bawaris	18·0	68·9
Others	11·4	3·4
TOTAL ..	100·00	100·0

Distance from outlet

9.0 Secure and assured water supply is an important determinent of farm productivity and variations in supply are central to a study of this aspect. The distance from the source of supply affects the quantum and regularity of water supply and would be an important variable. In general, it may be said that greater the distance from the outlet and greater, therefore the transit losses, the greater is the possibility of fluctuations in the water supplied at the farm end. In the colony, generally, it has been observed that the maintenance of these outlets is better than that of the water courses or 'Khallas' which are entirely managed by the cultivators themselves. The water courses often get choked with silt and other refuse material obstructing the even flow of water and consequently affecting the quantity. Leaving out of consideration, the difference in the supply position between various outlets located as they are at varying distances from the headworks or the main feeding points, an attempt is made to compare the farms with reference to three specified categories of distance from the outlet, that is less than one mile, one to three miles and over three miles. The implicit assumption in such a comparison is that the farms which are more favourably situated could be expected to give a better return to the input of irrigation in terms of incraesed output values. To what extent this single factor *viz.* location would affect farm productivity, however, is a question which will involve considerable detailed analysis and re-arrangement of data. There is no doubt, however, that such an enquiry is integral to sound project planning and layout of the distributary systems. For the present, therefore, the locational position of the farms under study may be examined with a view to explaining possible differences in farm characteristics.

9.1 It would be seen from Table No. 5.14 that in the irrigated zone, a greater proportion of the holdings (57 per cent) are situated at distances varying from 1 to 3 miles from the outlet. The distance here is reckoned in terms of the length of the water course or 'khalla' which takes off from the outlet in the perennial zone again, more farms are closer to the outlet in the Ganganagar-Padampur tract. While this feature is more true of the farms under perennial irrigation, farms are more advantageously situated in the non-perennial zone in that about 42 per cent are within a mile of the outlet.

TABLE NO. 5.14

Distribution of irrigated farms by location

(with reference to outlet)

Distance	Irrigated		
	Perennial	Non-perennial	Total
(1)	(2)	(3)	(4)
Less than 1 mile	107	10	117
	(30·2)	(41·7)	(31·1)
1 to 3 miles	203	13	216
	(57·3)	(54·2)	(57·1)
Over 3 miles	2	—	2
	(0·6)	—	(0·5)
Partly in one or another	42	1	43
	(11·9)	(4·1)	(11·4)
TOTAL	354	24	378
	(100·0)	(100·0)	(100.0)

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The location of farms with reference to the single factor of the village outlet is accidental and not necessarily conditioned by or related to the area of the holding. However, in general, it would be seen that the smaller the farm, the more advantageously it is located. With the increase in the area of the farm locational disadvantage increases and this is so both in perennial or non-perennial zones. These locational differences, apparently, independent in themselves are known to determine such aspects of the farm economy as choice of crops and yield and to a less significant extent, the farm inputs. There is no significant change in water supply between different outlets but it has been a common complaint that those at the tail end of the channels with their reduced capacity do not receive an adequate and even flow of supplies. To this extent, chaks situated at the tail end of the channels are affected adversely and not infrequently provide a fruitful source of violence and village feuds.

CHAPTER VI

INVESTMENT AND EMPLOYMENT

Investment effects of irrigation

1.0 The additional farm production resulting from irrigation is due as much to the more direct expenditure on the canal and appurtenant works as to the investments made by the farmers. These latter which are sometimes termed as "associated costs" consist of both expenditures on current farm operations and the more permanent investments in farm business. As the changes in farm costs have been analysed in the next chapter, it is proposed to study here the additional investment opportunities created under conditions of irrigation. In this respect, figures of fixed capital comprising items such as owned land and farm buildings, implements and livestock are particularly useful and bring to light the impact of irrigation on farm investment.

1.1 From figures in Tables No. 6.0 showing particulars of fixed capital it will be observed that irrigation induces considerable farm investment. For convenience sake, data on fixed capital are presented separately for all items of capital including land as also for the more reproduceable items of capital as farm buildings, implements and livestock. It is seen that fixed capital including land amounts to Rs. 19,646 on an average holding in the commanded zone as against Rs. 2,858 in the uncommanded zone. Investment is thus nearly eight times larger with irrigation. On the larger farms receiving perennial irrigation, the size of capital is even frequently higher. On the other hand, investment is smaller on non-perennial farms. Area-wise analysis showed that investment was much lower in Anupgarh area, that is, 70 per cent less than the average for the commanded area. Inter-village differences were also conspicuous in the Barani zone where investment varied from Rs. 49 per acre in Anupgarh to as much as Rs. 322 in areas nearer Ganganagar. Considering capital limited to farm buildings, implements and livestock, it is seen that it amounts to Rs. 2,300 per holding and Rs. 114 per acre in the commanded zone as against Rs. 1,090 and Rs. 52, respectively in the uncommanded zone. (Table No. 6.0-A). Thus the fixed capital is over twice as large with irrigation as without it. The distribution of the capital further suggests that the major step up in investment is in respect of farm implements, where the increase under conditions of canal irrigation is as much as thirteen times. This reflects largely the switch over from traditional to improved farm implements as also investment in certain types of equipment as cane crushers, oil presses etc. attendant on introduction of new crops in the area. It is noteworthy that in the project area not only the value of capital increases in absolute terms with the increase in the area of the holding, but that, per acre of cultivated area, the value of investment is consistently higher in all size groups as compared to Barani zone.

TABLE

Value of fixed capital (Land, Farm

Zone	0—5		5—10		10—15	
	Per farm	Per acre	Per farm	Per acre	Per farm	Per acre
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Irrigated						
Perennial ..	1,786	545	6,517	815	9,983	769
Non-perennial ..	4,873	1,350	13,907	1,563	7,008	567
Total (Irrigated) ..	2,142	647	6,600	824	9,735	752
Barani	1,335	417	1,925	247	2,349	189

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No. 6·0

Buildings, Implements and Livestock)

(Rs. per farm and per acre)

15·25		·25 -50		50 & above		All Farms	
Per farm	Per acre	Per farm	Per acre	Per farm	Per acre	Per farm	Per acre
(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
16,829	936	36,829	1,080	1,39,656	1,096	19,922	983
17,322	832	23,945	765	61,879	1,088	15,585	852
16,858	929	35,679	1,054	1,35,081	1,096	19,646	976
2,079	121	4,218	135	7,841	124	2,858	135

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TABLE NO.

Values of fixed capital (Land, Farm)

Particulars	0—5		5—10		10—15	
	Total	Per Farm/ acre	Total	Per Farm/ acre	Total	Per Farm/ acre
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Perennial—						
(*i*) Farm Buildings	2,310	50 (15)	10,785	124 (15)	6,130	139 (11)
(*ii*) Implements ..	4,388	95 (29)	23,096	265 (33)	14,968	340 (26)
(*iii*) Livestock ..	28,687	624 (190)	83,014	954 (119)	44,578	1,033 (78)
Total (i-iii) ..	35,385	769 (234)	1,16,895	1,343 (168)	65,676	1,492 (115)
(*iv*) Land	46,750	1,016 (310)	4,50,040	5,173 (647)	3,73,583	8,491 (653)
Total (i-iv) ..	82,135	1,785 (544)	5,66,935	6,516 (815)	4,39,259	9,983 (768)
Non-Perennial						
(*i*) Farm Buildings	600	100 (28)	200	200 (22)	325	81 (6)
(*ii*) Implements ..	631	105 (29)	457	457 (51)	1,373	343 (28)
(*iii*) Livestock ..	6,100	1,017 (282)	1,850	1,850 (208)	2,975	744 (60)
Total (i-iii) ..	7,331	1,222 (339)	2,507	2,507 (282)	4,673	1,168 (95)
(*iv* Land	21,908	3,651 (1012)	11,400	11,400 (1281)	23,360	5,840 (473)
Total (i-iv) ..	29,239	4,873 (2351)	13,907	13,907 (1562)	28,033	7,008 (568)
All Irrigated						
(*i*) Farm Buildings	2,910	56 (7)	10,985	124 (15)	6,455	134 (10)
(*ii*) Implements ..	5,019	96 (29)	23,553	268 (33)	16,341	340 (26)
(*iii*) Livestock ..	34,787	669 (202)	84,864	964 (120)	47,553	991 (76)
Total (i-iii) ..	42,716	821 (248)	1,19,402	1,357 (169)	70,349	1,465 (113)
(*iv*) Land	68,658	1,320 (398)	4,61,440	5,244 (655)	3,96,943	8,270 (639)
Total (i-iv) ..	1,11,374	2,141 (646)	5,80,842	6,600 (824)	4,67,292	9,735 (752)
Barani						
(*i*) Farm Buildings	—	—	515	52 (7)	625	78 (6)
(*ii*) Implements ..	150	50 (16)	464	46 (6)	494	62 (5)
(*iii*) Livestock ..	1,780	593 (185)	6,517	652 (84)	8,650	1,081 (87)
Total (i-iii) ..	1,930	643 (201)	7,496	750 (97)	9,769	1,221 (98)
(*iv*) Land	2,075	692 (216)	11,750	1,175 (150)	9,025	1,128 (91)
Total (i-iv) ..	4,005	1,335 (417)	19,246	1,925 (247)	18,794	2,349 (189)

6-A

Buildings, Implements and Livestock)

(In round Rupees per farm and per acre)

15—25		25—30		50 and above		all farms	
Total	Per Farm/ acre	Total	Per Farm/ acre	Total	Per Farm/ acre	Total	Per Farm/ acre
(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
18,726	170 (9)	15,790	310 (9)	19,300	1,206 (9)	73,041	206 (10)
92,055	837 (47)	1,09,615	2,149 (63)	51,065	3,191 (63)	2,95,186	834 (41)
1,26,830	1,153 (64)	1,00,001	1,961 (57)	68,703	4,294 (34)	4,51,813	1,276 (63)
2,37,611	2,160 (120)	2,25,406	4,420 (129)	1,39,068	8,691 (68)	8,20,040	2,316 (114)
16,13,574	14,669 (815)	16,52,892	32,409 (951)	20,95,428	1,30,964 (10·28)	62,32,267	17,605 (869)
18,51,185	16,829 (935)	18,78,298	36,829 (1080)	22,34,496	1,39,655 (1096)	70,52,307	19,921 (983)
1,800	257 (12)	920	184 (6)	500	500 (9)	4,345	181 (10)
7,888	1,127 (54)	2,132	426 (14)	419	419 (7)	12,900	537 (29)
8,775	1,253 (60)	10,815	1,163 (69)	1,360	1,360 (24)	31,875	1,328 (73)
18,463	2,637 (126)	13,867	2,773 (89)	2,279	2,279 (40)	49,120	2,046 (112)
1,20,790	14,684 (705)	1,05,856	21,171 (676)	59,600	59,600 (1048)	3,224,914	13,538 (740)
1,21,253	17,321 (831)	1,19,723	23,944 (765)	61,879	61,879 (1088)	3,74,034	15 (852)
20,526	175 (10)	16,710	298 (9)	19,800	1,165 (9)	77,386	205 (10)
99,943	854 (47)	1,11,747	1,995 (59)	51,484	3,028 (24)	3,08,086	815 (40)
1,35,605	1,159 (64)	1,10,816	1,979 (58)	70,063	1,421 (53)	4,83,688	1,279 (63)
2,55,074	2,188 (121)	2,39,273	4,273 (126)	1,41,347	8,314 (67)	8,69,160	2,299 (114)
17,16,364	14,670 (807)	17,58,748	31,406 (928)	21,55,028	1,26,766 (1028)	65,57,181	17,347 (861)
19,72,438	16,858 (928)	19,98,021	35,679 (1054)	22,96,375	1,35,080 (1095)	74,26,341	19,646 (975)
2,193	37 (2)	2,740	76 (2)	625	208 (3)	6,698	56 (3)
3,581	61 (3)	2,420	67 (2)	477	159 (2)	7,588	64 (3)
59,510	1,009 (59)	34,640	962 (31)	4,170	1,390 (22)	1,15,267	969 (46)
65,284	1,106 (46)	39,800	1,105	5,272	1,757 (27)	1,29,553	1,089 (52)
57,388	973 (51)	1,12,030	3,112 (99)	18,250	6,083 (96)	2,10,518	1,769 (83)
1,22,672	2,079 (121)	1,51,830	4,217 (134)	23,522	7.840 (124)	3,40,071	2,858 (135)

TABLE No. 6.1

Percentage distribution of fixed capital under various items

Assets	0·5	5·10	10·15	15·25 -	25·50	50 & above	All Farms
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Irrigated							
Land	61·65	79·44	84·94	87·92	88·02	93·85	88·30
Farm Buildings	2·01	1·89	1·38	1·04	0·84	0·86	1·04
Livestock	31·23	14·62	10·18	6·87	5·55	3·05	6·51
Implements	4·51	4·05	3·50	5·07	5·59	2·24	4·15
TOTAL	100·00	100·00	100·00	100·00	100·00	100·00	100·00
Barani							
Land	51·81	61·05	48·02	46·78	73·79	77·58	61·90
Farm Buildings	—	2·68	3·33	1·79	1·81	2·66	1·97
Live stock	44·44	33·86	46·02	48·51	22·81	17·23	33·90
Implements	3·75	2·41	2·63	2·92	1·59	2·03	2·23
TOTAL	100·00	100·00	100·00	100·00	100·00	100·00	100·00

1.2 A break up of the above figures by the principal constituent items is given in Table No. 6.1. Land is the single biggest item of investment, in both the zones although in the commanded zone, the relative investment is greater. Thus, for instance, farm land accounts for 88 per cent of the total value in the canal zone while in the Barani zone, it is only 62 per cent. The lower percentage of investment in land in the Barani area may be as much due to the lower value of land prevailing here as also to the fewer number of persons with owned land. On the contrary, the percentage investment in an item like livestock is considerably higher or 34 per cent while the corresponding figure is 6.5 per cent in the project area. This is somewhat suggestive of the greater reliance placed on livestock in the Barani area with its uncertain agriculture. While livestock investment is greater on Barani farms, in the irrigated area, the percentage investment in farm implements is higher. Brief comments may be offered on each one of these items.

Land

2.0 Table No. 6.2 gives figures of value of owned land and farm buildings for various holding groups. In the commanded area it amounts to Rs. 17,552 per farm and Rs. 872 per acre or over ten times larger with irrigation. Investment in this item is lower in the non-perennial zone and in the Anupgarh area within the perennial zone mainly due to fewer persons reporting owned land here. The size of investment varies between different farms that is while it generally increases with the area in absolute terms, relative to the acreage it declines.(1) Investment in farm buildings is small in relation to the total value of land. Of importance however, is the fact, that nearly three-fourths of the farmers have their own farm structures while in the Barani area their number is negligible. By farm building is meant mainly cattle shed which usually is not an independent structure but a part, rather an extension of the farmers dwelling house. There is no distinction in this respect between irrigated and unirrigated villages.

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(1) The foregoing averages relates to all the sample farms. If on the contrary, only the reporting cases are considered, the general level of investment invariably rises. Thus the overall average per irrigated farm would be Rs. 22,930/- as against Rs. 5,000/- in the Barani area *i.e.* over 4 times larger with irrigation. This disparity is not significantly different when the figures are compared in terms of area.

TABLE NO. 6.2

Investment in fixed capital (land and farm buildings only)

Size group	Perennial			Non-Perennial			Total Irrigated			Barani		
	Total	Per-farm	Per acre	Total	Per-farm	Per acre	Total	Per farm	Per acre	Total	Per farm	Per acre
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
0—5	49·060	1,060·52	325·8	22,508	3,751·33	1,039·6	71,568	1,376·31	415·5	2·075	691·67	215·9
5—10	4,60,825	5,296·84	662·2	11,600	11,600·00	1,303·4	4,72,425	5,368·47	670·3	12,265	1,226·50	157·5
10—15	3,79,713	8,629·82	664·3	23,685	5,921·25	479·7	4,03,398	8,404·12	649·7	9,650	1,206·25	97·1
15—25	16,32,300	14,839·00	825·0	1,04,590	14,941·43	717·3	17,36,890	14,845·21	817·6	59,581	1,009·85	58·8
25—50	16,68,682	22,719·25	959·9	1,06,776	21,355·20	682·6	17,75,458	31,704·61	837·0	1,14,770	3,188·06	101·9
50 and obove	21,14,728	1,32,170·50	1,037·3	60,100	60,100·00	1,056·6	21,74,828	1,27,931·06	1037·8	18,875	6,291·67	99·5
Total	63,05,308	17,811·06	879·0	3,29,259	13,719·12	749·9	66,34,567	17,551·76	871·5	2,17,216	1,825·35	86·3

2.1 In this context value of irrigated farm land assumes some significance. Perhaps no other item provides as complete an account of the lasting impact of irrigation as the increment in the capital value of land. From figures in Table No. 6.3 which shows the average value of farm land in different reaches of the canal, it would be observed that overall, the value of irrigated land registers an increase of three to four times the value of unirrigated land. There is no significant difference in value of land as between different size groups of holdings. The variation however is quite marked in respect of land located in different areas in the commanded zone. The land value is consistently lower in the Anupgarh area situated at the tail end of the canal as compared to farms located in the upper reaches of the canal and receiving perennial irrigation. Even so, in relation to uncommanded farms the divergence in value of land is quite marked. The increase in value of land is nearly fourfold even with provision of non-perennial irrigation.

TABLE NO. 6.3

Value of Land

(In round Rupees per acre)

Zone	0— 5	5—10	10—15	15—25	25—50	50 & above	Average
Perennial							
Ganganagar-Padampur	1,180	1,105	1,167	1,088	1,139	1,084	1,104
Anupgarh	780	939	820	969	1,009	1,026	966
Non-Perennial							
Ganganagar	1,012	1,287	745	915	687	1,048	858
Raisinghnagar	—	—	576	768	640	—	656
Barani							
Ganganagar	320	320	320	320	260	40	293
Anupgarh	—	—	80	75	91	—	83

2.2 The value of land has increased sharply over the years and bears no comparison to the original price paid by the settlers. Besides, there have been brisk sales in land during the post-war years and figures of land sales present a variegated picture of rise in land values in different places and periods. Land value depends on factors like soils, location, permanent improvements etc. apart from the factor of water supply and to isolate the effects of a single factor like irrigation requires detailed investigation. The farms under study are fairly identical in respect of such aspects as soils and crops in various zones and sub-zones. Locational differences wherever they exist are not of such import as to make appreciable difference to the value of land. Moreover, there are hardly any permanent improvements in these farms apart from the annual maintenance of the irrigation sluices and water courses. Under these conditions, the differential price of land could be assumed as due to the factor of irrigation and the nature of water supplies. This would seem to be corroborated by the fact that land values have been observed to be considerably lower in areas with limited irrigation and in villages located at the fail end of the canal system. It may be added here that the data relate to recent land transactions in the villages. In enquiries of this nature farmers generally tend to understate the land values to avoid stamp duties and to ward off imposition of fresh taxes. While an element of personal judgment might thus have crept into these figures, it is unlikely that the average values have been affected to such an extent as to vitiate the main conclusions indicated.

Implements

3.0 Investment in dead-stock amounts to Rs. 815 on an average irrigated farm or Rs. 41 per acre (Table No. 6.4). The implement wealth is thus thirteen times larger in the canal zone. However, the implement value varies between perennial and non-perennial farms, and is lower by about 25 per cent in the non-perennial farms. The average figure in the non-perennial zone is based largely on the lower investments reported by the larger farms.

3.1 The figures clearly bring out the difference in the nature of these implements. In the commanded zone, the higher investment reflects purchase and use of better or improved types of implements while in the Barani area, a greater proportion of expenditure under this item is really on traditional implements with higher rates of depreciation. These differences are further brought out in Table No. 6.5 showing breakdown of investment under the main categories of implements. It would be observed that investment is considerably higher in the commanded area even in respect of such implements as fodder cutters, seed drills, ploughs etc. which are in common use both within and outside the commanded area. Greater investment in implements with relatively lower life in the Barani area would mean higher recurring expenses. From a further scrutiny of implement data, it appears that the investment in minor implements declines relatively with the increase in the farm size in both the commanded and uncommanded areas.

3.2 In considering the above figures, it should be noted that more households in the irrigated area have reported such investments. For instance, all the larger farm households with over 50 acres of holdings have their own bullock carts and fodder cutters (largely bullock-driven) while about 94 per cent have reported possession or iron ploughs (Table No. 6.6).

TABLE NO. 6.4

Investment in farm implements (Rs. per acre and per farm)

size groups	IRRIGATED						BARANI	
	Perennial		Non-perennial		Total			
	Per acre	Per farm	Per acre	Per farm	Per acre	Per farm	Per acre	Per farm
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
0—5	29·34	95·4	29·16	105·2	29·05	96·4	15·60	50·0
5—10	33·19	265·4	51·32	456·7	33·42	276·6	5·96	46·4
10—15	26·18	340·1	27·81	343·2	26·32	340·4	4·97	61·8
15—25	46·53	866·8	54·09	1,126·8	47·04	854·2	3·53	60·7
25—50	63·05	2,149·3	13·36	426·5	58·98	1,995·5	2·15	67·3
50 and above	25·05	3,191·5	7·36	419·0	24·56	3,028·4	2·52	159·1
TOTAL	41·15	834·0	29·38	537·5	40·47	815·0	2·92	63·8

TABLE NO. 6.5

Investment in Farm Implements (Rupees per acre of cultivated area)

Implements	Irrigated			Barani
	Perennial	Non-Perennial	Total	
(1)	(2)	(3)	(4)	(5)
Ploughs :				
(*i*) Wooden	0·48	0·68	0·49	0·43
(*ii*) Iron	0·63	0·72	0·64	0·04
Bullock-hoe	0·25	0·22	0·25	0·01
Clod-crusher	0·31	0·39	0·32	0·14
Yoke-Plants Tanged	0·35	0·38	0.35	0·28
Seed-drill	0·16	0·40	0·18	0·08
Boiling-Pan	0·47	0·07	0·45	—
Cane-crusher	3·39	—	3·21	—
Cooling Tray	0·09	—	0·08	—
Fodder-Cutter	2·25	2·19	2·25	0·29
Bullock-cart	8·54	6·61	8·42	0·15
Tractor	20·69	13·67	20·29	—
Other implements	3·54	4·05	3·54	1·50
TOTAL	41·15	29·38	40·47	2·92

A direct relationship may be seen between the number of households possessing the implements and the area of holding. In other words, the larger the farm the greater the number of persons, owing these implements. Considering an item like cane crusher, these are obviously found in greater use in areas with special concentration of sugar cane cultivation. Tractors are owned by about 4 per cent of households in the commanded area. On the other hand in the Barani area even a widely used implement like the iron plough is reported only by 5 per cent of the cultivators. Also an implement like fodder cutter which is in extensive use in the commanded villages have been reported by 12 per cent of the Barani cultivators. Bullock carts and tractors are rarely seen in these villages. The lower investment in farm equipment in the Barani area is thus a feature that may be associated with lower capital formation. It is noteworthy that even on larger farms, the investment in implements is relatively small. Indeed it was observed that not a single Barani farm in the Anupgarh area reported holding of any of the major implements.

Livestock

4.0 As regards livestock, data suggests that invesment per acre is higher by about 39 per cent in the irrigated area (Table No. 6.7). The acreage investment, however, is higher in the non-perennial zone, besides that there are also differences in the categories of animals owned, between these two

TABLE No. 6.6

Percentage distribution of sample farms owning improved implements

Size group	Irrigated						Barani			
	Bullock cart	Tractor	Iron plough	Seed drill	Cano crusher	Fodder cutter	Bullock cart	Iron plough	Seed drill	Fodder cutter
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
0—5	13·4	—	30·7	3·8	—	38·5	—	—	33·33	—
5—10	39·6	—	39·6	5·7	4·5	50·0	—	10·0	10·0	—
10—15	56·2	—	60·4	4·1	27·1	77·1	—	—	25·0	12·5
15—25	59·8	5·1	70·1	13·6	29·9	71·8	3·4	5·1	6·8	10·2
25—50	80·3	12·5	82·1	23·2	45·4	89·3	—	5·6	11·11	19·4
50 and above	100·0	11·8	94·1	47·1	76·5	100·0	0·5	—	—	—

TABLE No. 6.7

Value of Livestock held (Rupees per holding and per acre of operated area)

Size Group	Irrigated						Barani	
	Perennial		Non-Perennial		Total			
	Per farm	Per acre	Per farm	Per acre	Per farm	Per acre	Per farm	Per acre
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
0—5	623·0	190·5	1018·7	281·7	669·0	202·0	593·3	185·2
5—10	954·2	119·3	1850·0	207·9	964·4	120·4	651·7	83·7
10—15	1013·1	78·0	743·8	60·2	990·7	76·6	1081·3	87·0
15—25	1153·0	64·1	1253·6	60·2	1159·0	63·2	1008·6	58·7
25—50	1960·8	57·5	2163·0	69·1	1978·9	58·5	962·2	30·8
50 and above	4293·9	33·7	1360·0	23·9	4221·3	33·4	1390·0	22·0
TOTAL	1276·3	63·0	1328·1	72·6	1279·0	63·5	968·6	45·8

zones in the commanded area. For instance, a greater proportion of investment is in bullocks in the perennial zone particularly in Ganganagar and Pandampur chaks. In the nonperennial zone, there is more investment in milch animals. The number of camels in the latter zone is also slightly higher in comparison to the perennial zone. A principal distinction between the Irrigated and Barani areas, however, is the greater holding of other animals like sheep and goats in the Barani area particularly in Anupgarh. In general, the average investments under draught and milch animals are lower in the Barani area, the difference being more conspicuous in respect of milch cattle (Table No. 6.8).

TABLE NO. 6.8

Value of livestock by principal categories

(Rupees per farm and acre of operated area)

Zone	0—5		5—10		10—15		15—25		25—50		50 and above		Total	
	Draught	Milch	Draught	Milch	Draught	Milch	Draught	Milch	Draught	Milch	Draught	Milch	Draught	Milch
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Perennial	361·7 (110·5)	246·3 (75·3)	562·3 (70·3)	354·1 (44·3)	601·0 (46·3)	390·2 (30·0)	637·2 (35·4)	487·5 (27·1)	1168·5 (34·3)	723·3 (21·2)	2637·2 (20·7)	1544·8 (12·1)	745·4 (36·8)	493·1 (24·3)
Non-Perennial ..	526·7 (146·0)	490·0 (135·8)	1040·0 (116·9)	760·0 (85·4)	415·0 (33·6)	328·8 (26·6)	642·2 (30·8)	605·7 (29·1)	1100·0 (35·1)	1063·0 (34·0)	1000·0 (17·6)	350·0 (6·1)	702·3 (38·4)	621·6 (34·0)
All Irrigated	380·8 (114·9)	274·5 (82·9)	567·8 (70·9)	358·7 (44·8)	585.5 (45·3)	385·1 (29·8)	637·5 (35·1)	494·6 (27·2)	1162·4 (34·4)	753·6 (22·3)	2540·9 (20·6)	1476·6 (12·0)	742·7 (36·9)	501·2 (24·9)
Barani	400·0 (124·9)	183·3 (57·2)	410·5 (52·7)	217·0 (27·9)	580·6 (46·7)	109·4 (8·8)	527·7 (30·7)	166·1 (9·7)	566·1 (18·1)	291·1 (9·3)	936·7 (14·8)	453·3 (7·2)	540·1 (25·5)	212·0 (10·0)

NOTE :—Figures in brackets indicate per acre investment in livestock.

4.1. An analysis of the composition of work animals indicates the greater substitution of bullocks by camels in the Barani area because of the lower maintenance cost of the camels. In the project area there are 2.3 bullocks per farm and 0.2 camels while in the Barani area the corresponding figures are 0.6 and 0.9 respectively (Table No. 6.9). The distribution of draught cattle in the nonperennial zone is somewhat similar to that of the Barani zone i.e. there is approximately one animal per farm. Even so, it should be mentioned that while all the farm households in the nonperennial zone have reported draught animals, about 4 per cent of the households in the perennial zone do not have any such animals. Cattle assets increase with the size of the farm mainly in the commanded area. Considering the farm in the lowest size group, it is observed that about 1/6th of the households here do not have any draught animals. Both in absolute number and in relation to total livestock, these farmers have less cattle. In the Barani area, about 5 per cent of the farm households have not reported holding of any draught animals.

4.2. A comparison of the figures of area commanded by a pair of bullocks does not indicate any significant difference under irrigated conditions. On an average, in the irrigated zone, a pair of bullocks commands an area of 15 acres while in the Barani zone it is somewhat higher or 18 acres. On larger farms, the area per pair of bullocks is larger suggesting better utilisation of bullock labour here. Thus it increases from about 4 acres in the case of small farms to over 33 acres in the case of those with an area of over 50 acres.

TABLE No. 6.9

Distribution of Draught Animals

Size Group	Perennial				Non-Perennial				Irrigated				Barani			
	Draught Cattle				Draught Cattle											
	Average No. per holding		Percentage to total	Area commanded per pair of Bullocks	Average No. per holding		Percentage to total	Area commanded per pair of Bullocks	Average No. per holding		Percentage to total	Area commanded per pair of Bullocks	Average No. per holding		Percentage to total	Area commanded per pair of Bullocks
	Bullocks	Camels			Bullocks	Camels			Bullocks	Camels			Bullocks	Camels		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
0—5	1·2	0·2	7·5	4·0	0·5	0·8	17·8	3·3	1·3	0·3	8·1	3·9	1·0	0·7	2·9	2·8
5—10	1·9	0·1	20·7	7·2	2·0	1·0	6·6	4·5	2·0	0·2	20·0	7·1	0·7	0·6	7·6	8·2
10—15	1·9	0·2	10·3	11·8	1·0	0·3	11·1	16·5	2·0	0·2	10·3	12·1	0·1	1·3	6·4	9·5
15—25	2·2	0·1	29·2	14·9	1·0	0·7	26·7	17·2	2·3	0·1	29·0	15·1	0·6	0·8	46·2	16·0
25—50	3·0	0·3	19·4	18·8	1·2	1·4	28·9	15·6	3·2	0·4	19·9	18·5	0·6	1·0	31·6	25·6
50 and above ..	6·5	0·6	12·9	33·4	2·0	2·0	8·9	19·0	6·6	0·7	12·7	32·8	2·0	1·0	5·3	31·6
TOTAL	2·3	0·2	100·0	15·2	1·0	0·9	100·0	13·3	2·3	0·2	100·0	16·2	0·6	0·9	100·0	18·4

4.3. The distribution of milch animals also follows closely that of the draught animals. There are 2.2 milch animals per irrigated holding as against one animal per holding in the Barani zone. In relation to cultivated area, *i.e.* per 100 acres of cultivation, however, the number of milch animals in the irrigated zone is double that obtaining on the Barani farms (Table No. 6.10). Further, about 11 per cent of the households in the irrigated zone have not reported holding of any milch animals. In the Barani area on the other hand, this percentage is highest that is about 37 per cent. In general, there are more she-buffaloes in the commanded area where as in the Barani area, cows predominate. This feature reflects the preferences of farm communities rather than any consideration of their relative costs. Farm-wise figures suggest that relative to the cultivated area, there are more of milch animals on smaller farms. With the increase in the farm area, their number decreases and this feature is observed in both the irrigated and Barani zones.

4.4 In respect of young stock and other non-farm animals, it has been observed that their number is generally higher in the Barani zone. Of significance is the category of non-farm animals, mainly sheep and goats. Particular concentration of these animals has been observed in Anupgarh where on an average, there are 32 animals per holding. Apparently, where production of crops represents a certain measure of risk, as in the Barani area, there is greater investment and dependence on livestock.

Total Assets

5.0 Adding to the items enumerated so far the value of real estate and other financial assets or savings, it would be seen that the size of total assets increases relatively more in the project area. On an average, the total assets amount to Rs. 22,383 on a project farm which is roughly 525 per cent more than on the corresponding Barani farm (Table No. 6.11) Per acre again, the values are higher being Rs. 1,100 and Rs. 169 respectively. The general variations between farm groups and zones as observed under various items of investment are also equally applicable. Further the conspicuous concentration of assets on large farms is indicated in figures in Table 6.12 which shows the percentage distribution of assets. Farms in the highest group which constitute only 4 per cent of the total, account for nearly a third of the total value of assets. The next two lower groups together account for 53 per cent of the assets distributed about equally. Even in the Barani area, the assets are particularly large in the two groups 15 to 25 and 25 to 50 acres which together account for 81 per cent of the assets.

5.1 The financial assets including savings, cash deposits, cash on hand, ornaments and jewellery etc., could not be estimated with the same degree of accuracy as other assets. The villager is reticent if not suspicious about questions relating to such assets and the tendency often is to understate these assets. While, therefore not much reliance can be placed on

TABLE NO. 6.10

Distribution of milch animals

(Adult animals)

Size group	Perennial			Non-Perennial			Irrigated			Barani		
	Average No. per holding	Percentage to total	Average No. per 100 acres	Average No. per holding	Percentage to total	Average No. per 100 acres	Average No. per holding	Percentage to total	Average No. per 100 acres	Average No. per holding	Percentage to total	Average No. per 100 acres
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
0—5 ..	1·2	8·0	37·1	1·8	17·7	50·8	1·5	8·8	38·9	1·0	2·4	21·2
5-10 ..	1·4	17·1	17·2	4·0	6·5	44·9	1·4	16·2	17·6	0·6	4·9	7·7
10—15 ..	1·5	9·7	11·9	1·7	11·3	14·2	1·7	9·8	12·1	0·9	5·7	7·0
15—25 ..	2·0	31·1	11·1	2·7	30·7	13·0	2·2	31·1	11·2	0·9	43·9	5·3
25—50 ..	3·0	21·2	8·6	3·6	29·0	11·5	3·3	21·8	8·8	1·3	37·4	4·1
50 and above	5·7	12·9	4·5	3·0	4·8	5·3	5·0	12·3	4·5	2·3	5·7	3·7
TOTAL	2·0	100·0	9·8	2·6	100·0	14·1	2·2	100·0	10·1	1·0	100·0	4·9

the data, they do however, serve to indicate generally, the greater preference of Barani farmers for liquid assets, largely to meet the day-to-day cash requirements of the farm. It is also noteworthy that while the small farmer holds his savings mainly in jewellery and ornaments, those in the higher groups invest in institutional savings. The percentage value of this item also decreases considerably with the increase in farm area.

TABLE No. 6.11

Total assets of Sample Farms (Rupees per holding and per acre of operated area)

Size group	Irrigated			Barani
	Perennial	Non-Perennial	Total	
(1)	(2)	(3)	(4)	(5)
0—5	2,457·73	5,656·54	2,826·82	1,760·00
	(750·70)	(1567·63)	(853·38)	(549·43)
5—10	7,780·68	15,106·75	7,863·93	2,292·65
	(972·78)	(1697·39)	(881·93)	(294·50)
10—15	11,795·76	7,925·75	11,473·26	3,083·04
	(908·05)	(642·15)	(886·91)	(248·11)
15—25	19,161·53	20,202·00	19,223·79	2,792·74
	(1065·37)	(969·78)	(1058·81)	(162·52)
25—50	42,231·58	25,797·68	40,782·48	5,029·95
	(1239·54)	(824·63)	(1205·29)	(160·72)
50 and above	1,54,468·79	66,679·00	1,49,304·69	9,132·42
	(1212·29)	(1172·27)	(1211·21)	(144·42)
All Farms	22,720·59	17,409·61	22,383·26	3,580·82
	(1121·21)	(951·69)	(1111·43)	(169·29)

NOTE :—Figures within brackets are the average per acre of operated area.

TABLE No. 6.12

Percentage distribution of total assets for various size groups

Size Group	Irrigated			Barani
	Perennial	Non-Perennial	Total	
(1)	(2)	(3)	(4)	(5)
0—5	1·4	8·12	1·74	1·24
5—10	8·42	3·62	8·18	5·38
10—15	6·45	7·59	6·51	5·79
15—25	26·20	33·84	26·58	38·67
25—50	26·79	30·87	26·99	42·49
50 and above	30·73	15·96	30·00	6·43
All Farms	100·00	100·00	100·00	100·00

Real Estate

6.1 In relation to the total value, the proportion of investment under the head 'real estate' is small although it is over twice as large in Barani area as in the Irrigated area. More cultivators have their own houses in the Barani area that is, about 92 per cent as against 84 per cent in the project area (Table No. 6.13). This feature is observed in all the farm groups but the proportion of cultivators with better houses is a little more in the irrigated area that is 3.8 per cent as against 0.9 per cent in the Barani area. In general, no substantial differences in types and structures have been observed. During the year of enquiry again, no significant increase in demand for new construction material in the irrigated area was observed. The higher unit value of property in the colony (nearly 1½ times more than the Barani area or Rs. 1.54 per sq. ft. as against Rs. 0.87) is not so much indicative of the better type of structures in the project area as possibly the greater floor space available per household. This is also suggested by the figures of average area per household which works out to 6.09 sq. ft. in the commanded area as against 286 s. ft. in Barani villages.

TABLE NO. 6.13

Percentage distribution of farmers by type of residential property owned

Size group	Irrigated				Barani			
	Pucca	Kutcha	Mixed	Total	Pucca	Kutcha	Mixed	Total
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
0—5 ..	5·88	70·59	23·53	65·38	—	—	—	-
5—10 ..	—	61·64	38·36	82·95	—	44·44	55·56	90·00
10—15 ..	2·38	57·14	40·48	87·50	—	50·00	50·00	100·00
15—25 ..	2·02	50·50	47·48	84·62	—	46·30	53·70	91·53
25—50 ..	7·55	56·60	35·85	94·64	2·78	61·11	36·11	100·00
50 and above ..	17·65	17·65	64·70	100·00	—	33·33	66·67	100·00
All farms ..	3·77	55·35	40·88	84·13	0·91	50·91	48·18	92·44

NOTE :—Figures in Cols. (5) and (9) are percentages of total farm household in each roup, while the others represent percentage break-up of total houses owned.

THE EMPLOYMENT ASPECT

Animal Labour

7.0 If investment is an outcome of greater security of return from land, employment which is equally an important indirect effect of irrigation arises from, and in turn conditions, greater farm production. The adoption of more intensive methods of cultivation following from an assured water supply involves increased outlay on farm and animal labour. Considering firstly the question of utilisation of animal resources, it is possible to say that in general irrigation has stepped up demand for bullock labour; the larger the farm the higher the utilisation of bullock labour. It has been observed that on an average irrigated farm, employment of bullock labour amounts to 120 days. Per acre of irrigation, it is 6 days which is about twice as high as that obtaining in the Barani area. These figures naturally vary between different farms from a minimum of 24 days on small farms to a maximum of 620 days on very large farms (Table No. 6.14). The greater number of days observed on larger farms is merely indicative of the fact that more pairs of bullocks are worked and not infrequently more than 8 hours a day. While the animal labour increases in absolute value with the increase in the size of the farm, relatively to the cultivated area, it declines. Within the irrigated area, no material difference is observed in the utilisation of bullock labour between perennial and nonperennial zones. Perhaps in the latter, the animal labour is slightly higher particularly in the case of larger farms. On the whole however, it is comparable in different farm groups.

TABLE NO. 6.14

Average Bullock labour days

Size group	Perennial		Non-Perennial		Irrigated		Barani	
	Per farm	Per acre	Per farm	Per acre	Per farm	Por acre	Per farm	Per acre
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
0—5	23·37	7·13	27·18	7·53	23·81	7·19	11·33	3·53
5—10	64·76	8·10	77·59	8·71	64·91	8·11	38·45	4.94
10—15	81·43	6·27	78·60	6·37	81·20	6·27	42.25	3·40
15—25	108·62	6·04	145·56	6·98	110·82	6·10	53·83	2·13
25—50	195·41	5·73	180·55	5·77	194·09	5·73	97·63	3·12
50 and above	630.67	1·95	450·75	7·92	620·08	5·03	149·50	2·36
TOTAL	119·49	5·90	121·94	6·67	119·64	5·93	66·35	3·14

7.1 The animals are mainly owned and rarely rented for cash. This is generally true of both irrigated and Barani farms. Very few farms have reported hiring of bullocks on cash basis and these are situated mostly in chaks around Ganganagar (Table No. 6.15). Further the animals are rented mainly by the smaller farmers. This, however is not to suggest that in terms of animal power, the sample farms under study are adequately equipped. The above figures particularly in the case of small farms conceal the fact of a large proportion of animal labour which is obtained on exchange basis, a system widely prevalent in the area. The extent of hiring of bullocks negligible in the Barani area because animal labour in this area mainly consists of camel labour.

TABLE No. 6.15

Bullock labour (owned and hired)

(Per holding and per acre of operated area)

Size group	Irrigated			Barani		
	Hired	Owned	Total	Hired	Owned	Total
(1)	(2)	(3)	(4)	(5)	(6)	(7)
0—5	0·25	23·56	23·81	—	11·33	11·33
	(0·08)	(7·11)	(7·19)	(—)	(3·53)	(3·53)
5—10	0·71	64·20	64·91	—	38·45	38·45
	(0·09)	(8·02)	(8·11)	—	(4·94)	(4·94)
10—15	—	81·20	81·20	—	42·25	42·25
	—	(6·27)	(6·27)	—	(3·40)	(3·40)
15—25	1·54	109·28	110·82	—	53·83	53·83
	(0·08)	(6·02)	(6·10)	—	(3·13)	(3·13)
25—50	—	194·09	193·09	0·36	97·27	97·63
	—	(5·73)	(5·73)	(0·01)	(3·11)	(3·12)
50 and above ..	—	620·08	620·08	—	149·50	149·50
	—	(5·03)	(5·03)	—	(2·36)	(2·36)
All Farms	0·68	118·96	119·64	0·11	66·24	66·35
	(0·03)	(5·90)	(5·93)	(0·01)	(3·13)	(3·14)

NOTE:—Figures within brackets are the averages per acre of operated area.

Farm Labour

8.0. Figures of intensity of human labour expressed in man-days suggest that an average irrigated farm of 20 acres provides work of the order of 390 man-days as against 177 days on a comparable farm in the uncommanded area. (Table No. 6.16). Additional employment per acre of irrigated area is thus 138 per cent. The employment level however, varies markedly between different farm groups, and with perennial and non-perennial irrigation. Labour days per acre also decline with increase in the size of farm which is suggestive of decreasing inputs and economy of scale. In other words, more area is commanded by the same unit of farm labour on larger farms. Within the commanded area again employment figures are higher in the non-perennial zone in all size groups with the exception of those in the group 25 to 50 acres. These figures in the main reflect the conditions of farms under Lalgarh channels where the water supply position is better and compares favourably with that in the perennial zone. The higher employment here is also an index of the more intensive cropping practices followed. This is an area dominated by cotton cultivation which gives rise to considerable concentration of labour. Even so, it is significant that while the step up in farm employment between different holding groups is fairly gradual under perennial irrigation, in the non-perennial zone, no such trend is observed. Labour is provided mainly by the farmer himself or jointly with other members of the family. The larger farmers have 'siris' or permanent farms servants. One of the important effects of canal irrigation is the increase in employment of labour of this category. For instance as many as 84 farms or 22 per cent of the sample particularly in the larger size groups have reported their own farm servants. 'Siris' however are an exception in the Barani area where only 2 farms or 1.7 per cent have such labour. We shall revert to a consideration of this aspect again in a subsequent chapter dealing with agricultural labour. The large demand for attached farm labour that above figure indicate is a measure of one of the principal indirect benefits of canal irrigation.

TABLE NO. 6.16

Human labour days

Size group	Perennial		Non-Perennial		Total Irrigated		Barani	
	Per farm	Per acre	Per farm	Per acre	Per farm	Per acre	Per farm	Per acre
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
0—5	86·13	26·31	102·35	28·36	88·00	26·57	40·67	12·69
5—10	171·88	21·49	258·00	29·00	182·86	21·58	96·25	12·36
10—15	254·34	19·58	266·38	21·58	255·34	19·74	111·88	9·00
15—25	271·45	20·65	543·06	26·07	381·69	21·02	158·88	9·24
25—50	653·62	19·18	568·60	18·18	646·03	10·09	255·67	7·21
50 and above	2087·61	16·38	1295·13	22·77	2041·00	16·55	621·50	2·25
Average	388·98	10·19	411·54	22·49	390·42	19·38	176·82	8·36

8.1 The greater demand for hired labour that irrigation generates may be seen in figures in Table No. 6.17 which gives a break-up of labour by family and hired. On an average irrigated farm, for instance, family and hired workers account respectively for 53 per cent and 47 per cent of total labour. On the other hand, in the Barani area the operator himself with the members of his family provides almost fully (90 per cent) the requisite labour force. There is a steady increase in proportion of hired labour with an increase in the size of farms although in the non-perennial zone such a trend is not discrenable. In the lower size groups again whether in irrigated or Barani zones farming is predominantly a family enterprise. It would howeved, be seen that when the holding reaches the group 25 to 50, respective shares of paid and unpaid labour in labour time are almost equal. This position, is however reached even earlier (*i.e.* those in the size group 15 to 25) in the non-perennial zone. It would further be observed that the variation in the proportion of hired and family labour generally is not so much as in the type of hired labour. For instance, in the Anupgarh area purely casual labour predominates, while on farms in Ganganagar the opposite is perhaps more true. In Barani area both on large farms and those in the lowest group, farmer's own family and friends provide the main labour force for most of the operations. It has also been noticed that in one area that is Anupgarh no hired labour of any sort has been reported during the year of the enquiry. Here as in the case of animal labour, a good part of labour shown under family labour is contributed on an exchange basis.

8.2 The increase in employment on project farms is in the main directly an outcome of irrigation, although the size of such an increase would depend on factors like crops grown size of the family etc. The increase in family employment is not so significant as the increase in employment of hired labour, particularly of the category of permanent labour. Per acre of area, it would be observed that for each day worked on a Barani farm, 67 additional days of permanent labour is recorded on farm with irrigation. For casual labour the increase in labour days is nearly six fold with irrigation.

Labour per acre of cropped area

9.0 The employment of human and animal labour as conditioned by irrigation is clearly brought out in Table No. 6.18 which gives labour per acre of cropped area. Altogether crop production on an acre of irrigated farm land involves a total of 21 man days in a year. In addition a pair of bullocks would be required to work for slightly over 6 days. These figures may be compared with 8 days of human labour and hardly 3 days of bullock labour in the Barani area. Apparently, irrigated farming involves doubling of animal labour while employment of human labour increases nearly threefold. More meaningful results could be obtained if we compared labour requirements under identical crop conditions. For this, however, further detailed investigation is required which

TABLE NO. 6.17

Distribution of family and hired farm labour

(Average Man-days per holding and percentaged distribution)

Size Group	Perennial		Non-Perennial		Irrigated		. Barani	
	Family	Hired	Family	Hired	Family	Hired	Family	Hired
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
0—5	77·06 (89·5)	9·07 (10·5)	94·18 (92·0)	8·17 (8·0)	79·03 (89·8)	8·97 (10·2)	38·00 (93·4)	2·67 (6·6)
5—10	144·72 (84·2)	27·16 (15·8)	258·00 (100·0)	— —	146·00 (84·4)	26·86 (15·6)	84·65 (73·0)	11·60 (27·0)
10—15	186·07 (73·2)	68·28 (26·8)	260·38 (97·7)	6·00 (2·3)	192·26 (75·3)	63·08 (24·7)	89·13 (79·7)	22·75 (20·3)
15—25	240·30 (64·7)	131·13 (35·3)	272·38 (50·2)	270·68 (49·8)	242·22 (63·4)	139·47 (36·6)	149·22 (93·9)	9·66 (6·1)
25—50	302·91 (46·3)	250·71 (53·7)	355·05 (62·4)	213·55 (37·6)	307·57 (47·6)	338·46 (52·4)	197·44 (87·5)	28·23 (12·5)
50 and above	372·74 (17·9)	1714·27 (82·1)	197·50 (84·7)	1097·63 (15·3)	362·44 (17·8)	1678·56 (82·2)	479·83 (92·2)	41·67 (8·0)
TOTAL	203·86 (52·4)	185·12 (47·6)	239·35 (58·2)	172·21 (41·8)	206·12 (52·8)	184·30 (47·2)	159·88 (80·4)	16·94 (9·6)

NOTE :—(*i*) Figures within brackets are the percentages.
(*ii*) Hired labour includes purely casual labour as well as labour of permanent farm servant.

it has not been possible to attemp within the time limits of the present study. Evidently farm work is determined by several factors such as cultivation and cropping techniques, soils and topography, scale of operation etc. The larger acreage under sugarcane and rice may give rise to more employment as is suggested by figures of farm labour in Anupgarh area. Similarly extensive cotton cultivation would make heavy demands on labour particularly casual labour which phenomena have been shown in the case of non-perennial farms. Within the Barani area, there is relatively more employment in the Ganganagar and Padampur villages as compared to Anupgarh.

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TABLE NO. 6.18

Human and Bullock labour days

(per acre of cropped area)

Zone	0-5		5-10		10-15		15-25		25-50		50 & above		All Farms	
	H	B	H	B	H	B	H	B	H	B	H	B	H	B
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Perennial	24·00	6·53	32·27	8·39	20·72	6·63	22·18	6·49	20·65	6·17	19·24	5·81	20·96	6·44
Non-Perennial ..	23·04	6·12	24·29	7·30	20·36	6·00	24·21	6·48	16·73	5·31	28·78	10·02	6·34	—
Irrigated ..	23·92	6·47	22·28	8·37	20·68	6·58	22·24	6·48	2·28	6·11	19·48	5·92	20·99	6·43
Barani	12·70	3·54	11·36	4·54	7·65	2·89	8·29	2·81	7·52	3·25	10·28	2·95	8·18	3·07

Note :— H—Human labour
B—Bullock labour

CHAPTER VII

FARM BUSINESS

Coverage and general limitations

1.0 The primary and direct benefit of irrigation consists in the added farm product. The additional expenses which the farmers have to incur to help realise this benefit represent the primary indirect effect of irrigation. In the following paragraphs the broad effects of irrigation emerging from our survey of farm business have been set down, first separately for crop production and livestock enterprises and later in terms of farm business income as a whole.

1.1 Monetary estimation of benefits on the basis of one year's data could hardly be described as unbiased or representative. The year of enquiry 1958-59 was particularly favourable for the uncommanded or barani area. The crop yields in that area were generally above normal and in particular gram had a bumper harvest, the yield being 8.8 mds. per acre which was higher than the district average of 7.4 mds. per acre. Exceptionally good rainfall with favourable distribution was the principal contributory factor. The total rainfall recorded in the reference year of enquiry was practically double the quantum of average rainfall during the preceding five years. On the contrary, in the commanded zone the crops were not particularly good. There was considerable damage to cotton crop as a result of late rains, the average output being reduced to less than half the normal yield. This made a big dent into farm income particularly in the non-perennial zone. The yields of other crops also were less than the normal outturn of crops in the colony. In considering estimates of crop production and costs presented in the subsequent sections, due allowance will have to be made for these abnormal conditions. Besides, in a study of this type involving direct enquiry, the attitude of the respondent and the tact of the investigator all too closely determine the extent of reliability of data reported. The latter aspect was sought to be ensured with fairly intensive training of the investigation staff and the pre-testing of the schedules besides frequent spot checks and supervision during various stages of the study. Statistical tests applied to response of the cultivators have also given encouraging results. Even so, an element of underestimation of output or over-estimation of costs is conceivable. As far as possible, output figures were checked with comparable data from crop cutting estimates, first estimates of yields prepared by the revenue department etc.

1. CROP PRODUCTION

Average yields

2.0 It will be observed from the figures in Table No. 7.0 that irrigation increases outturn of crops both in physical and value terms. While in general the average yields are 2 to 3 times higher with assured water, the difference is frequently even greater in respect of particular crops and areas.

TABLE No. 7.0

Gross produce and average yield of crops

Crops	Irrigated			Barani		
	Area (acres)	Quantity (maunds)	Value (Rs.)	Area (acres)	Quantity (maunds)	Value (Rs.)
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Sugarcane	173 ·74	79,538 ·00	1,07,930 ·35	—	—	—
		(457 ·80)	(621 ·22)	—	—	—
Cotton	1,607 ·72	5,521 ·75	1,71,902 ·65	—	—	—
		(3 ·43)	(106 ·92)	—	—	—
Oil seeds	432 ·10	2,496 ·06	56,681 ·75	506 ·29	1,490 ·00	19,747 ·25
		(5 ·78)	(131 ·18)		(2 ·94)	(39 ·00)
Wheat	2,007 ·68	26,267 ·65	3,91,034 ·25	350 ·87	1,612 ·25	22,668 · 50
		(13 ·08)	(194 ·77)		(4 ·60)	(64 ·61)
Gram	766 ·47	8,185 ·50	86,301 ·00	342 ·34	3,020 ·25	34,157 ·50
		(10 ·68)	(112 ·60)		(8 ·82)	(99 ·78)
Rice	97 ·51	1,810 ·00	26,126 ·50	—	—	—
		(18 ·47)	(267 ·94)			
Mixed	536 ·21	6,757 ·55	71,636 ·50	491 ·99	2,966 ·25	34,063 ·75
		(12 ·60)	(133 ·60)		(6 ·03)	(69 ·29)
Fodder crops	1,162.48	1,76,398 ·25	1,70,129 ·75	482 ·82	2,493 ·50	3,288 ·00
		(151 ·74)	(146 ·35)		(5 ·16)	(6 ·81)
Others	246 ·82	3,450 ·65	30,772 ·75	399 ·79	1,151 ·38	11,900 ·42
		(13 ·98)	(124 ·68)		(2 ·88)	(29 ·77)
TOTAL	7,030 ·73		11,12,515 ·50	2,574 ·10		1,25,825 ·42
			(158 ·24)			(48 ·88)

N.B. : —1. Figures in brackets represent average value per acre.

2. The yield figures in cols. (3) and (6) are exclusive of bye-products.

3. **Output has been valued in terms of prices prevailing in the market at the time of harvest *i.e.* prices actually received by the farmers.**

excluding purely irrigated crops such as rice, sugarcane and cotton, the yields are appreciable in respect of crops like wheat and mixtures of wheat, oilseeds and gram which are common crops in both areas of study. The production per acre under irrigation is also substantial in respect of fodder crops. The comparison in this group, however, is limited as the value figures are averages for a variety of crops. The last group of miscellaneous crops include mainly vegetables, pulses etc. Although the yield differential is highest here, obviously no significance can be attached to this group in view of the widely varying characteristics of the crops some of which could not be grown under dry-farming conditions. For all crops taken together production with irrigation is well over three times as large as in the uncommanded zone. This is particularly significant considering that the year of reference was exceptionally favourable to the barani zone.

2.1 Value of output obviously varies with the type of crops produced. Thus while the output of sugarcane is the highest both in physical and value terms, the yield of gram per acre is the lowest. For reasons already stated, the output of cotton also is low. Variations in crop yields between different villages within the commanded zone have not been noticeably large unlike those in the Barani zone. A notable feature, again, is that for all crops together, value of gross output per acre of operated area is highest in the case of small farms both in the commanded and uncommanded zones. This is due to larger proportion of more valuable crops being cultivated in the smaller holdings as also higher intensity of cropping here.

TABLE NO. 7.1

Value of crops (Gross) per acre of operated and cropped area

(Rs. per acre)

Size group (acres)	Irrigated		Barani	
	Operated area	Cropped area	Operated area	Cropped area
(1)	(2)	(3)	(4)	(5)
0—5	179	161	96	96
5—10	173	178	96	89
10—15	162	170	73	62
15—25	169	180	50	45
25—50	171	181	60	63
50 and above	152	178	49	61
Average	165	178	57	56

NOTE :— 1. On assumption that the standard deviations of gross value of crops per operated acre raised in the irrigated and unirrigated areas were the same, the difference in the two unweighted average values was found to be statistically significant. With same assumptions for the two sets of data regarding value of crops per cropped area in irrigated and unirrigated zones, the average values for the two areas were found to be significantly different at 1% level of significance.

2. The overall average has been calculated with reference to the weighted diagram used in the sampling design.

2.2 It will be observed from the above Table that gross output per operated acre generally declines with the increase in the size of the farm in the commanded zone. In relation to cropped area, this trend is somewhat reversed. In either case no consistent trend is in evidence. On the other hand, in the Barani zone, there is only a downward trend in output whether in terms of operated or cropped area. One explanation for the lower output with increase in size of farms is the extent of fallow area. Fallows tend to increase with the area of the farm with the result that unit output is reduced in relation to total area. On area actually sown with crops, however, this is raised. Per cropped acre maximum output is observed on farms in the size group 25 to 50 acres in the irrigated zone while in the unirrigated zone small farms have recorded the highest output. The variations in crop output between different farms is more pronounced in the barani zone.

Sale of crop produce

2.3 A glance at figures in Table No. 7.2 suggests the comparatively greater sale of farm produce in the Barani zone. This is observed in all the farm groups with the exception of those in the lowest category where no sales have been recorded. It is common to regard higher cash incomes as a characteristic of progressive farming, particularly in economically advanced countries. In an under-developed economy, however, this assumption would not be valid because it is the most unsuccessful and financially hard-pressed farmers who dispose of a substantial part of their crops in order to meet various financial obligations. On the contrary, on farms which are better stabilized, the various annual operations are largely self-financed, that is the requirements are largely met from the farm itself. This means, on the one hand, better consumption of the farm household, greater provision for seeds etc. and on the other, smaller marketable surpluses especially in respect of foodgrains. The sales of foodgrains in the irrigated zone, for instance, account for 52 per cent of the total farm sales while in the barani zone, they account for 69 per cent. The extent of farm sales is also determined by crop pattern, where cash crops predominate, as in the case of non-perennial zone, the sales are also correspondingly higher.

TABLE No. 7.2

Value of crops sold as per cent of gross produce

Size group (acres)	Perennial	Non-perennial	Irrigated	Barani
(1)	(2)	(3)	(4)	(5)
0—5	31·7	43·9	33·4	—
5—10	32·1	26·4	32·0	45·0
10—15	32·9	57·1	34·3	44·3
15—25	37·6	47·4	38·2	42·2
25—50	35·4	32·0	35·2	50·4
50 and above	52·4	49·5	52·2	54·7
All Farms	39·8	42·4	40·0	46·9

Farm expenses

2.4 The intensive character of irrigated agriculture is reflected in higher production expenses, both fixed and operating. In this respect it will be observed from figures in Table No. 7.3 that cost of cultivation per acre is over three times larger with irrigation. To express it differently, under fairly identical conditions irrigation induces a three-fold increase in farm expenses. While this is an overall condition, the extent of increase in production cost varies on different farms and according to the concept of cost used.(1) The estimates of cost for the purposes of this study have been framed on two assumptions. Under the first or Basis 'A' assumption all items of cost that is those actually incurred in cash or kind and those whose values are imputed have been accounted. Under the second or Basis 'B' assumption imputed items of cost have been eliminated. On both the assumptions the maximum inputs per acre are observed in respect of small holdings in both the zones of study. The inputs per acre on either assumption again decline with increase in the farm size suggesting economies of scale. This feature is applicable to both the commanded and uncommanded farms although in the latter case cost declines even sharply. Inputs per acre are highest in the non-perennial zone.

TABLE NO. 7.3

Inputs (Rs. per acre) on crop production

Size group (acres)	Perennial		Non-perennial		Irrigated		Barani	
	Basis 'A'	Basis 'B'	Basis 'A'	Basis 'B'	Basis 'A'	Basis 'B'	Basis 'A'	Basis 'B'
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
0—5	281·5	233·7	315·2	244·7	285·7	235·1	150·4	124·1
5—10	194·5	155·4	245·8	173·4	195·2	155·6	93·8	72·5
10—15	154·2	123·0	165·8	115·6	155·1	122·4	64·3	49·8
15—25	157·4	124·1	175·5	136·2	158·6	124·9	48·6	32·9
25—50	150·9	123·3	113·8	80·9	147·9	121·6	43·4	31·6
50 and above ..	110·0	96·2	104·3	90·7	109·9	96·0	38·8	25·5
All Farms ..	148·3	121·7	151·5	144·4	148·5	121·3	47·9	34·0

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[1] The term 'cost of production' in farm economics has different connotations. Where interfarm comparisons are made of farms differing in their characteristics (owned and self-cultivated or tenant-cultivated : owned capital and equipment or borrowed) provision for adjustments for such costs in order that differing incomes are placed on an uniform basis should be made. This is attempted in cost basis 'A' estimates which correspond to the 'residual' method of estimation of farm income. It is, however, important to make a distinction between those costs which represent cash or kind investments and those for which values are attributed, to provide for a complete account of all expenses. For this reason, the estimates in this chapter are presented separately on two different assumptions 'A' and 'B'. Except where otherwise stated 'cost' should be taken to mean basis 'A' estimates. For a more detailed discussion on methods of farm business analysis, please see section 3 of 'Methods of Farm Management Investigation' published by F.A.O.

2.5 A more detailed examination of the cost structure would be helpful in indicating the extent and direction of increase in intensity. Figures in Table No. 7.4 suggest that while irrigation inputs are increased, the most conspicuous increase is observed under current expenses such as farm labour (wages of human and animal labour), fertilisers and other material inputs. The increase is also pronounced on fixed items such as rent and taxes. In relation to total cost, wages of farm labour constitute the most important item both in the canal and Barani zones, although proportionately such charges are even higher in the latter zone. Next to farm labour, expenditure on seeds, is higher in the barani zone. The absolute value per acre, however, is lower in comparison with irrigated farms. We may now examine in some detail the more important items of inputs.

TABLE No. 7.4

Expenses on crop production

(Rs. per acre)

Particulars	Perennial		Non-Perennial		Irrigated		Barani	
	Rs.	Per cent	Rs.	Per cent	Rs.	Per cent	Rs.	Per cent
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1. *Wages to Labour*	34·5	23·2	46·9	31·0	35·2	23·7	14·8	30·9
(*i*) Paid ..	17·5	11·7	19·9	13·2	17·6	11·8	3·1	6·4
(*ii*) Unpaid ..	17·0	11·5	27·0	17·8	17·6	11·9	11·7	24·5
2. Bullock Labour	44·9	30·3	52·7	34·8	45·4	30·5	16·4	34·3
3. Seeds ..	10·6	7·1	7·4	4·9	10·4	7·0	6·6	13·8
4. Fertilizers and Manures ..	9·1	6·1	8·3	5·5	9·0	6·1	—	—
5. Repairs and Maintenance of Implements, depreciation etc.	12·9	8·7	9·0	6·0	12·7	8·5	2·1	4·4
6. Customary Payments ..	2·5	1·7	2·9	1·9	2·5	1·7	0·9	1·9
7. *Taxes* ..	7·7	5·2	6·9	4·5	7·7	5·2	0·5	1·0
(*i*) Land Revenue ..	2·7	1·8	1·6	1·0	2·6	1·7	0·4	0·8
(*ii*) Water charges ..	4·6	3·1	5·0	3·3	4·7	3·2	—	—
(*iii*) Local Cess	0·4	0·3	0·3	0·2	0·4	0·3	0·1	0·2
8. *Rent* ..	16·4	11·1	9·5	6·2	16·0	10·8	2·0	4·2
(*i*) Paid ..	11·2	7·6	3·8	2·5	10·8	7·3	1·4	2·9
(*ii*) unpaid ..	5·2	3·5	5·7	3·7	5·2	3·5	0·6	1·3
Interest on fixed Capital ..	4·5	3·0	4·5	2·9	4·5	3·0	1·7	3·4
10. Miscellaneous expenses	5·3	3·6	3·4	2·3	5·2	3·5	2·9	6·0
TOTAL ..	148·3	100·00	151·5	100·00	148·5	100·00	47·9	100·00

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Farm labour

2.6 The charges on farm labour are shown under the two principal categories of family and hired labour. Considering the latter category, it would appear that with irrigation, wage costs are six-times larger as compared to the uncommanded farms. Further, the outlay on hired labour in project area constitutes 50 per cent of the total labour cost *i.e.* approximately the same as the value of family labour. In the uncommanded zone, however, such charges account for only 20 per cent of the farm wages or 6% of total farm cost. This is an index of the larger employment opportunities created by canal irrigation because wage rates in the irrigated zone are not higher than in the adjacent Barani zone. The employment aspect has been examined in some detail in a subsequent chapter. It is clear, however, that both in absolute and relative terms paid labour is lower in the uncommanded zone while within the commanded zone such charges are highest on non-perennial farms.

2.7 In respect of family labour, however, the picture is somewhat different inasmuch as the operator's own labour and that of his family in the uncommanded zone is an important element, constituting as it does nearly one-fourth of the total farm cost. In the commanded zone the imputed wages of family labour account for 12 per cent of the total inputs. The average value per acre, however, is higher with irrigation and is the maximum in the non-perennial zone. It may be added here that the cost of family labour in the irrigated zone was estimated with reference to the average wages of permanent farm servants. Similar basis has been adopted in respect of such labour in the Barani zone, although in actual practice, there is no system of engaging permanent farm servants here. Indeed the labour cost would be, if anything, higher in the Barani zone if this was computed in terms of wages paid to unattached or casual labour. However, this method was adopted in accordance with the directions of the Committee of Direction and for ensuring comparability of conditions in the absence of the factor of irrigation. It should be noted that this procedure has under-rated the cost of family labour somewhat in the uncommanded zone.

Bullock labour charges

2.8 The next important component of cost, which is at least as significant as wages of human labour in farm business, is the cost of bullock labour. It will be observed that the expenditure under this item is also nearly thrice as large with irrigation as without. Within the irrigated zone again the cost per acre as also the relative share of this labour to the total inputs are higher in the non-perennial zone. The main ingredient of this expenditure is obviously the cost of feed which accounts for 68 per cent and 56 per cent respectively in the commanded and uncommanded zones (Table No. 7.5). Greater part of this expenditure represents farm produced feed in the commanded zone. To this extent the likely indirect effects arising from, say, greater purchase of feed crops and concentrates are not likely to be significant. Apart from this item, labour charges on upkeep of animals are higher in relation to total cost in the Barani zone. In general our computations indicate higher maintenance expenditure in the irrigated zone

TABLE NO. 7.5

Maintenance cost per pair of adult bullocks

S. No.	Particulars	Perennial		Non-Perennial		Irrigated		Barani	
		Rs.	Per cent	Rs.	Per cent	Rs.	Per cent	Rs.	Per cent
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1.	Feed	540·86	68·73	769·64	77·88	551·98	68·93	296·62	56·38
2.	Depreciation (net)	117·34	14·91	142·70	13·33	118·56	14·81	101·29	19·25
3.	Labour Charges on upkeep ..	127·74	16·23	155·28	14·50	129·08	16·12	127·52	24·24
4.	Veterinary charges etc. ..	1·03	0·13	3·05	0·29	1·13	0·14	0·65	0·13
5.	Total (1 to 4)	786·97	100·00	1070·67	100·00	800·75	100·00	526·08	100·00
6	Less receipts	55·54		42·55		54·90		17·90	
7	Net Cost (5-6)	731·43		1028·12		745·85		508·18	
8.	Bullock Labour days	95·44		129·99		97·12		96·13	
9.	Cost per bullock labour day ..	7·66		7·91		7·68		5·28	

signifying not only that there is greater holding of animals per farm but also better care and maintenance of the draft animals.

Taxes

2.9 An important element in the calculation of indirect benefits of irrigation is the larger land revenue receipts of the State Government and the other taxes to the local bodies. A detailed discussion of this aspect appears elsewhere in this report. Confining ourselves mainly to the results of farm business survey, it would be seen that with irrigation, land revenue collections have increased nearly six times. The Local Bodies whose incomes are linked to size of revenue collections have also obtained corresponding benefits. For instance, on an average, local cesses are four times larger. Figures of incidence of land revenue further suggest that it is generally higher in the perennial zone that is Rs. 2.65 as against Rs. 1.54 in the non-perennial zone. Correspondingly, therefore, the local cesses are higher in the former zone. These figures include collection charges and other costs attendant on administration of the taxes. On the whole, it is observed that such charges approximate to 5 per cent of collections and would not, materially affect the results. Water rate, however, is in the nature of a direct charge or price for the supply of water. Collections from this source, therefore, represent a direct return on investment and would not figure in estimation of the indirect benefits.

Other inputs

2.10 Among other changes in inputs affected by irrigation, expenditure on chemical fertilizers and manures is, perhaps, the most outstanding. On an average, outlay under this item is Rs. 9 per acre in the commanded zone, which is 6 per cent of the total inputs. Roughly, half of this expenditure is on nitrogenous fertilizers (mainly Ammonium Sulphate and Urea) which supplements farm-yard manure. It is noteworthy that this item does not figure at all in the budget of the Barani farmer. Indeed, not un-often, the little farmyard manure that is collected by these farmers represents a disposable item rather than an essential input on their farms. The greatly increased demand for chemical fertilizers would not have been possible without canal irrigation. In respect of seeds as well, the input value per acre is higher with irrigation. It is generally observed that farmers in the commanded zone have taken to better varieties of seeds and improved methods of farming. While the average input per acre in this respect is lower in the uncommanded zone, such expenditure, however, constitutes higher proportion of the total farm cost indicating that the seed requirements are mainly met by off-farm purchases. In the commanded zone, however, these are largely met from the previous crops. The higher charge under depreciation and maintenance of farm implements in the commanded zone again is an index of the larger investment in improved implements.

2.11 It will be observed from Table No. 7.4 that rent payments are substantially higher with irrigation despite the fact that a larger proportion of the Barani farms is under tenant cultivation. The rental systems are, however, not comparable in the two zones of study since in the commanded zone the rents are mainly in 'kind' or 'batai'. The rent payment includes the value of crop share without being adjusted for landlords' own contributions in terms of seeds, manures etc. While the 'net rent' thus might get reduced, the magnitude of difference is not likely to be so large as to affect the comparison materially. On the other hand, with prevailing system of cash rents, the rent payments both in absolute and relative terms are fairly negligible in the uncommanded zone.

Net output

2.12 The net output or profit provides a good index of success in farming. This has been estimated with reference to both the cost concepts. The net output computed on cost basis 'A' corresponds somewhat to the concept of pure profit as it allows for all items of inputs, in accordance with the normal accounting principles and based on the opportunity cost concept. Net output on basis 'B' excludes all the imputed items of inputs, and therefore, provides a measure of return to the farmer for his labour and that of his family as also returns for risk and management. In other words, this approximates to the cost as a farmer himself would reckon. Estimates on these two different assumptions are given in Tables No. 7.6 and 7.7. Considering firstly the return on cost concept 'A', project farms show a net output of Rs. 17.4 per acre as against Rs. 9.3 in the uncommanded zone. While this is the overall position, farms in the lowest size group show negative returns both in the commanded and uncommanded zones. Farms with an area of 10 acres and above have recorded increasing net output in the commanded zone, the maximum of Rs. 42 per acre obtaining in the largest holdings. Within the irrigated zone again, farms in the non-perennial area have, however, recorded negative returns with the exception of those in the size groups of 25 to 50 acres and over 50 acres. In the main, this may be attributed to the extensive damage to the cotton crop which is an important crop here. The yield of this crop in the year of reference was less than half the normal yield. Besides, a comparison of inputs would indicate the higher intensive character of farming in this zone. Because of these factors, the non-perennial farms make a rather bad showing. On the contrary, in the perennial zone with greater diversification of cropping, larger proportion of sample farms have recorded surpluses. In the uncommanded zone the maximum net return is recorded by holdings in the size group 25 to 50 acres. No consistent trend, however, has been observed here.

2.13 On the basis of cost concept 'B', the net output is even larger with irrigation that is, twice as large or Rs. 45 per acre here as compared to Rs. 23.3 per acre in Barani zone. Farms of less than 5 acres in both the zones of study have recorded negative returns. On an average, the maximum net return is observed in respect of large holdings of over 50 acres in the commanded zone. Net returns increase with the size of the farm in the commanded zone although similar trend is not observed in the Barani

TABLE No. 7.6

Net output (in Rs.) from crops—(basis 'A')

Size Groups (Acres)	Perennial			Non-Perennial		
	Output	Input	Net Output	Output	Input	Net Output
(1)	(2)	(3)	(4)	(5)	(6)	(7)
0—5	27,609·46 (183·33)	42,394·85 (—) (281·50) (—)	14,785·39 (98·17)	4,290·12 (198·16)	6,824·69 (—) (316·23) (—)	2,534·57 (117·07)
5—10	1,21,591·25 (174·73)	1,35,603·75 (—) (194·87) (—)	14,012·50 (20·14)	1,100·50 (123·65)	2,187·53 (—) (245·79) (—)	1,087·03 (122·14)
10—15	96,449·69 (168·74)	88,107·04 (154·15)	8,342·65 (14·59)	5,989·37 (121·32)	8,186·07 (—) (165·81) (—)	2,196·70 (44·49)
15—25	3,39,626·38 (171·66)	3,11,307·19 (157·35)	28,319·19 (14·31)	22,490·50 (154·33)	25,590·46 (—) (175·49) (—)	3,099·96 (21·26)
25—50	3,03,530·54 (174·60)	2,62,395·92 (150·94)	41,134·62 (23·66)	22,524·25 (144·00)	17,806,·48 (113·84)	4,717·77 (30·16)
50 and above	3,11,531·00 (152·81)	2,24,379·77 (110·06)	87,151·23 (42·75)	6,553·00 (115·21)	5,931·55 (104·28)	621·45 (10·93)
All farms	12,00,338·32 (167·33)	10,64,188·52 (148·35)	1,36,149·80 (18·98)	62,947·74 (143·37)	66,526·78 (—) (151·53)	3,579·04 (8·16)

Note :—Figure in brackets indicates value per acre.

TABLE No. 7.6 (*Contd.*)

Size Group (Acres)	Irrigated			Barani		
	Output	Input	Net Output	Output	Input	Net Output
(1)	(8)	(9)	(10)	(11)	(12)	(13)
0—5	31,899·58 (185·19)	49,219·54 (285·74)	(—) 17,319·96 (—) (100·55)	953·00 (99·17)	1,445·36 (150·40)	(—) 492·36 (—) (51·23)
5—10	1,22,691·75 (174·09)	1,37,791·28 (195·52)	(—) 15,099·53 (—) (21·43)	7,503·00 (96·38)	7,299·16 (93·76)	203·84 (2·62)
10—15	1,02,439·06 (164·97)	96,293·11 (155·07)	6,145·95 (9·90)	7,217·00 (72·60)	6,394·47 (64·32)	822·53 (8·27)
15—25	3,62,116·88 (170·47)	3,36,897·65 (158·60)	25,219·23 (11·87)	50,982·13 (50·29)	49,220·68 (48·55)	1,761·75 (1·74)
25—50	3,26,054·79 (172·08)	2,80,202·40 (147·88)	45,852·39 (24·20)	68,252·00 (60·58)	48,940·80 (43·44)	19,311·20 (17·14)
50 and above	3,18,084·00 (151·79)	2,30,311·32 (109·90)	87,772·68 (41·89)	92,22·50 (48·62)	7,356·42 (38·78)	1,866·08 (9·84)
All farms	12,63,286·06 (165·94)	11,30,715·30 (148·53)	1,32,570·76 (17·41)	1,44,129·63 (57·26)	1,20,656·89 (47·94)	23,472·74 (9.32)

TABLE No. 7.7

Net output (in Rs.) from crops (basis 'B')

Size groups (Acres)	Perennial			Non-Perennial		
	Output	Input	Net Output	Output	Input	Net Output
(1)	(2)	(3)	(4)	(5)	(6)	(7)
0—5	27,609·46 (183·33)	35,191·57 (233·68)	(—) 7,582·11 (—) (50·35)	4,290·12 (198·16)	5,297·42 (244·68)	(—) 1,007·30 (—) (46·52)
5—10	1,21,591·25 (174·73)	1,08,135·27 (155·39)	13,455·98 (19·34)	1,100·50 (123·65)	1,543·24 (173·40)	(—) 442·74 (—) (49·75)
10—15	96,449·69 (16·74)	70,294·87 (122·98)	26,154·82 (45·76)	5,989·37 (121·32)	5,704·53 (115·55)	284·84 (5·77)
15—25	3,39,626·38 (171·66)	2,45,436·11 (124·05)	94,190·27 (47·61)	22,490·50 (154·23)	19,863·10 (136·21)	2,627·40 (18·02)
25—50	3,03,530·54 (174·60)	2,17,729·50 (125·25)	85,801·04 (49·35)	22,524·25 (144·00)	12,649·16 (80·87)	9,875·09 (63·13)
50 and above	3,11,531·00 (152·81)	1,96,024·82 (96·15)	1,15,506·18 (56·66)	6,553·00 (115·21)	5,160·78 (90·73)	1,392·22 (24·48)
All farms	12,00,338·32 (167·33)	8,72,812·14 (121·67)	3,27,526·18 (35·66)	62,947·74 (143·37)	50,218·23 (114·38)	12,729·51 (28·99)

Note : Figure in brackets indicates value per acre.

TABLE NO. 7.7 (*Contd.*)

Size groups (Acres)	Irrigated			Non-Irrigated		
	Output	Input	Net output	Output	Input	Net Output
(1)	(8)	(9)	(10)	(11)	(12)	(13)
0—5	31,899·58 (185·19)	40,488·99 (235·06)	(—) 8,589·41 (—) (49·87)	953·00 (99·17)	1,192·09 (124·05)	(—) 239·09 (24·88)
5—10	1,22,691·75 (174·09)	1,09,678·51 (155·63)	13,013·24 (18·46)	7,503·00 (96·38)	5,644·03 (72·50)	1,858·97 (23·88)
10—15	1,02,439·06 (164·97)	75,999·40 (122·39)	26,439·66 (42·58)	7,217·00 (72·60)	4,947·22 (49·77)	2,269·78 (22·83)
15—25	3,62,116·88 (170·47)	2,65,299·21 (124·89)	96,817·67 (45·58)	50,982·13 (50·29)	33,334·86 (32·88)	17,647·27 (17·41)
25—50	3,26,054·79 (172·08)	2,30,378·66 (121·58)	95,676·13 (50·50)	58,252·00 (60·58)	35,377·97 (31·58)	32,674·03 (29·00)
50 and above	3,18,084·00 (151·79)	2,01,185·60 (96·01)	1,16,898·40 (55·78)	9,22·50 (48·62)	4,840·26 (35·52)	4,382·24 (23·10)
All farms	12,63,286·06 (165·94)	9,23,03·37 (121·25)	3,40,255·69 (44·69)	1,44,129·63 (57·26)	85,536·43 (33·98)	58,593·20 (23·28)

zone.(²) What is significant, however, is that on either cost basis, net output in farming is higher generally with irrigation and is the maximum on cost basis 'B'.

II. LIVESTOCK PRODUCTION

Production from Livestock

3.0 Livestock production is an integral part of farm business and constitutes the second most important source of income to the farmer. From table No. 7.8, it will be observed that the value of livestock production is larger in the commanded area being Rs. 53.8 per acre as against Rs. 22.4 in the Barani area, i.e., about 140 per cent higher with irrigation. Within the commanded zone production is a little larger in the non-perennial zone with an average of Rs. 56 per acre here. It was observed that both in respect of number of milch cattle held as also production of milk, farms located nearer the district town of Ganganagar had an advantageous position. Production again is highest on small holdings both in the commanded and uncommanded zones signifying the pivotal position that livestock hold in small farming.

3.1 Figures in table No. 7.8 include mainly value of milk and milk products. Receipts from other categories of animals, e.g. sale of wool, constitute a small proportion in the commanded area, although this item is more pronounced in the barani zone particularly on small holdings. Even within the commanded zone these receipts are pronounced in Anupgarh area accounting for nearly half the total receipts. Anupgarh located at the tail-end of the canal represents a transitional stage from pastoral to one of specialised crop production.

3.2 Considering milk and milk products the yield per animal as also per acre in the irrigated zone is 30 per cent and 161 per cent higher respectively than in the barani zone (Table No. 7.9). Within the commanded area the output is higher in the non-perennial zone particularly in respect of smaller holdings. Per capita production is, however, higher in the perennial zone. It is also observed that the per capita figures are considerably higher in respect of small farms in the barani zone. In general, production is highest on small holdings and decreases with the scale of operation *i.e.* relative to area. On the contrary, the yield per animal registers increase with increase in the farm area. Production need not directly be determined by the scale of operation or area of the holding. It is, however, not unusual to expect that on larger holding with greater acreage under fodder and better resources, the animals are better fed and maintained with correspondingly larger yields. It must, however, be noted that the animal population in the two zones of study are not strictly indentical an aspect we had noted earlier. Buffaloes with their higher milk yields are predominant in the irrigated zone while

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²on the assumption of same standard deviations, the net returns from irrigated zones were observed to be statistically significant from those of Barani zone at 5 per cent level of significance.

TABLE No. 7.8

*Value of livestock products**

Size Group (Acres)	Perennial		Non-Perennial		Irrigated		Barani	
	Per Farm	Per Acre	Per farm	Per Acre	Per Farm	Per Acre	Per Farm	Per Acre
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
0—5	552·3	162·0	826·6	229·1	566·2	170·9	455·0	142·1
5—10	767·9	96·0	1,185·0	133·1	772·7	96·4	357·6	45·9
10—15	915·5	70·5	835·6	67·8	908·8	70·2	462·9	37·3
15—25	1,025·8	57·0	962·2	46·2	1,022·0	56·3	384·0	22·3
25—50	1,599·3	46·9	1,145·2	36·6	1,558·7	46·1	617·8	19·7
50 and above	3,713·6	29·1	2,540·0	44·7	3,644·6	29·6	907·7	14·4
All Farms	1,038·7	53·7	1,020·3	55·8	1,084·3	53·8	472·8	22·4

*Includes milk, milk products and miscellaneous receipts *e.g.*, farm yard and sale of wool.

TABLE NO. 7.9

Milk and milk products (per head of milch cattle and per acre)

Size Group (Acres)	Perennial		Non-Perennial		Irrigated		Barani	
	Per animal	Per acre	Per animal	Per acre	Per animal	Per acre	Per animal	Per acre
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
0—5	380	145	395	200	390	152	413	129
5—10	490	84	271	122	483	85	626	41
10—15	514	62	400	57	503	61	345	24
15—25	456	50	307	40	444	50	295	16
25—50	471	40	273	31	450	40	419	17
50 and above	573	26	730	39	587	26	348	13
All Farms	480	47	341	48	469	47	361	18

cows figure more in the barani zone. A comparison of livestock enterprise keeping the animal population constant in both the zones would, therefore, yield more meaningful conclusions.

Sale of Livestock Products

3.3 It is common knowledge that dairy production is not organised on any commercial basis in this country and milk, whether processed or unprocessed, is in the main consumed by the farm household. The Ganganagar area is no exception to this and although milk production constitutes about 88 per cent of livestock output in the project zone as against 80 per cent in the uncommanded zone, hardly 9 per cent is sold by the Project farmers as compared to 5 per cent in the barani zone (Table No. 7.10). Milk is sold mainly in the form of processed products as butter and ghee for which considerable demand exists in urban areas. Within the irrigated zone farms situated close to the Ganganagar and Padampur markets for instance, have reported higher sales, being as much as 12 per cent of production, while further down in Anupgarh tehsil such sales constitute only 2 per cent of production.

3.4 Between different farm groups, milk sales are invariably higher on smaller farms both in the commanded and uncommanded zones. Indeed in the barani zone, the percentage of sales is highest in respect of small farms. On closer look, however, this is found to be mainly influenced by sales in one large village 'Thakaranwali' situated close to Ganganagar. The small farmer, whether in the commanded or uncommanded zones, has to supplement his earnings from land largely through sale of livestock products. There is, however, no consistent relation between extent of sales and farm area.

Expenditure on Livestock

3.5 Figures in Table No. 7.11 relate to expenditure incurred mainly on account of milch animals along with their young stock. The expenditure on account of non-farm animals as sheep is negligible *i.e.* less than 1 per cent of the cost and as such the figures in the Table may be taken to represent overwhelmingly the cost of maintenance of farm animals. It would be seen that, on an average, expenditure per acre is nearly twice as much in the commanded zone as in the barani zone. In the non-perennial zone, the difference is even higher, that is, over four-times as large as in the barani zone. There is relatively greater holding of milch cattle in this zone, particularly on the smaller farms. Bulk of the expenditure is on feed crops and concentrates, as is evident from the breakdown of expenditure figures. Higher expenditure, both in absolute and relative terms on livestock feed is observed in the commanded zone. For instance, feed costs account for 78 per cent of the total cost in the project zone as against 65 per cent in the barani zone. In absolute value, the increase is as much as 335 per cent. The up-keep charges, which are an accounted item of cost, however, are higher in the barani zone. Both feed and labour charges are higher on non-perennial farms, although their relative proportions to total inputs are comparable to perennial farms. The better standards of feed and maintenance of animals in the commanded

TABLE No. 7.10

Milk and milk products sold

(As Percent of total produce)

Size Group (acres)	0—5	5—10	10—15	15—25	25-50	50 and above	All farms
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Perennial	13·7	10·9	8·7	10·8	9·3	1·0	9·0
Non-Perennial	13·1	—	—	2·4	—	30·1	6·5
Irrigated (Total)	13·6	10·8	8·0	10·4	8·7	2·2	8·8
Barani	19·4	1·3	9·1	5·9	3·0	—	4·6

TABLE No. 7.11

Expenditure on account of livestock (Rs. per acre and percentage)

Particulars	Perennial		Non-perennial		Total (Irrigated)		Barāni	
	Rs.	Percent	Rs.	Percent	Rs.	Percent	Rs.	Percent
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Feed and Concentrates	35·4	78·3	57·2	80·3	36·6	78·4	10·9	64·6
Depreciation (net)	0·5	1·1	(—)1·3	(—)1·8	0·4	0·8	0·9	5·3
On up-keeep	9·2	20·4	15·1	21·2	9·6	20·6	5·0	29·6
Miscellaneous	0·1	0·2	0·2	0·3	0·1	0·2	0·1	0·5
TOTAL	45·2	100·00	71·20	100·00	46·7	100·00	16·9	100·00

zone indicated by figures of expenditure may in some degree explain the larger production and sale of milk products here. It would be wrong to extend this assumption further as output is determined as much by other factors as number, type and age distribution of the animals held as relatively larger outlay on feed. It would also be seen from the discussion in the following section that notwithstanding a higher output, net output or profits do not show appreciable increase with irrigation. The ratio of output to input for instance is fairly the same in both the zones, *i.e.,* 0.9 and 0.8 respectively in the commanded and non-commanded zones.

Net returns from livestock

3.6 Estimates of net returns from livestock enterprise also have been worked out with reference to cost assumptions 'A' and 'B', the former including all items of expenses, including a charge for family labour on the upkeep of animals. This item has been excluded in the cost basis 'B'. It might be added, that under inputs, no account has been taken of interest on investment in livestock which was already covered under the main item of interest on fixed capital.

3.7 A comparison of net return on basis 'A' shows that on an average, the net return is slightly larger in the un-commanded zone. There is hardly any difference if the returns are estimated on basis 'B' (Tables No. 7.12 and 7.13). From figures in Table No. 7.12, it would be seen that net return from livestock is Rs. 3.8 per acre with irrigation while it is Rs. 4.9 per acre in the uncommanded zone. There is, however, marked difference between different farm groups. For instance, while the commanded farms in the size group 5 to 10 acres followed by those in the next higher group show larger net returns (these again mainly occur in the perennial zone), small farms with area less than 5 acres in the uncommanded zone have recorded the maximum net return of Rs. 65 per acre. It will be observed that while the output on these holdings is no doubt less as compared to the commanded farms of the same category, the inputs are considerably smaller yielding thus a sizeable return. The next higher returns in the barani zone have been recorded in respect of farms in the category of 10 to 15 acres. Within the commanded zone, the non-perennial farms show an overall negative return of Rs. 17.4 per acre as against a surplus of Rs. 5 per acre in the perennial zone. With the exception of very large farms, the sample holdings in this zone have recorded net losses of varying magnitude.

3.8 With the exclusion of family labour under inputs, the net returns from livestock are comparable in both the zones of study being Rs. 9.8 and Rs. 10 per acre respectively in the commanded and uncommanded zones (Table No. 7.13). As compared to earlier estimates, the net return is twice as high in the barani zone while the increase in the commanded zone is even larger. Here again, the returns are much larger in respect of small holdings both in the commanded and uncommanded zones. The maximum net return of Rs. 83 per acre is observed in respect of small holdings. Within the irrigated, zone, the net losses in non-perennial zone, are less on basis 'B', although the relative position of farms in different size groups is not materially

TABLE No. 7.12

Net output (in Rs.) from livestock—(*Basis 'A'*)

(Milch and other animals)

Size Group (Acres)	Perennial			Non-Perennial		
	Output	Input	Net Output	Output	Input	Net Output
(1)	(2)	(3)	(4)	(5)	(6)	(7)
0—5	23,203·22 (154·07)	21,813·90 (144·84)	1,389·32 (9·23)	4,821·59 (222·70)	4,910·37 (226·80)	(—)88·78 (—)(4·10)
5—10	61,979·87 (89·07)	46,121·55 (66·28)	15,858·32 (22·79)	1,154·23 (129·69)	1,861·81 (209·19)	(—)707·58 (—)(79·50)
10—15	37,564·37 (65·72)	27,705·54 (48·47)	9,858·83 (17·25)	3,140·48 (63·61)	4,308·79 (87·28)	(—)1,168·31 (—)(23·67)
5—25	1,06,623·76 (53·89)	1,03,470·47 (52·30)	3,153·29 (1·59)	6,517·96 (44·69)	8,729·68 (59·86)	(—)2,211·72 (—)(15·17)
25—50	75,787·36 (43·59)	74,812·83 (43·04)	974·53 (0·55)	5,499·57 (35·16)	9,499·30 (60·73)	(—)3,999·73 (—)(25·57)
50 and above	55,770·07 (27·36)	50,566·72 (24·80)	5,203·35 (2·56)	2,397·14 (42·14)	1,875·43 (32·97)	521·71 (9·17)
All Farms	3,60,928·65 (50·31)	3,24,491·01 (45·23)	36,437·64 (5·08)	23,530·97 (53·59)	31,185·38 (71·03)	(—)7,654·41 (—)(17·44)

TABLE No. 7.12 (*contd.*)

Size Group (Acres)	Irrigated (Total) Output	Irrigated (Total) Input	Irrigated (Total) Net output	Barani Output	Barani Input	Barani Net output
(1)	(8)	(9)	(10)	(11)	(12)	(13)
0—5	28,024.81 (162·69)	26,724·27 (155·14)	1,300·54 (7·55)	1,300·00 (135·27)	672·32 (69·96)	627·68 (65·31)
5—10	63,134·10 (89·58)	47,983·36 (68·08)	15,150·74 (21·50)	3,409·24 (43·79)	3,563·47 (45·77)	(—) 154·23 (—) (1·98)
10—15	40,704·84 (65·55)	32,014·33 (51·56)	8,690·52 (13·99)	3,676·82 (36·99)	1,463·50 (14·72)	2,213·32 (22·27)
15—25	1,13,141·72 (53·26)	1,12,200·15 (52·82)	941·57 (0·44)	22,059·94 (21·76)	17,206·34 (16·97)	4,853·60 (4·79)
25—50	81,286·93 (42·90)	84,312·13 (44·50)	(—)3,025·20 (1·60)	21,748·02 (19·30)	17,036·47 (15·12)	4,711·55 (4·18)
50 and above	58,167·21 (27·76)	52,442·15 (25·03)	5,725·06 (2·73)	2,602·81 13·72)	2,627·04 (13·85)	(—)24·23 (—)(0·13)
All Farms	3,84,459·62 (50·50)	3,55,676·39 (46·72)	28,783·23 (3·78)	54,796·83 (21·77)	42,569·14 (16·91)	12,227·69 (4·86)

Note : **Figure in brackets indicates average value per acre.**

TABLE NO. 7.13

Net output (in Rs.) from livestock—(Basis 'B')

(Milch and other animals)

Size Groups (Acres)	Perennial			Non-Perennial		
	Output	Input	Net-output	Output	Input	Net output
(1)	(2)	(3)	(4)	(5)	(6)	(7)
0—5	23,203·22 (154·07)	16,269·66 (108·03)	6,933·56 (46·04)	4,821·59 (222·70)	3,873·04 (178·89)	948·55 (43·81)
5—10	61,979·87 (89·07)	38,029·49 (54·65)	23,950·38 (34·42)	1,154·23 (129·69)	1,491·33 (167·57)	(—)333·10 (—)(37·88)
10—15	37,564·37 (65·72)	21,439·21 (37·51)	16,125·16 (28·21)	3,140·48 (63·61)	3,692·46 (74·79)	(—)551·98 (—)(11·18)
15—25	1,066,23·76 (53·89)	86,103·17 (43·52)	20,520·59 (10·37)	6,517·96 (44·69)	7,680·67 (52·67)	(—)1,162·71 (—)(7·98)
25—50	75,787·36 (43·59)	69,524·34 (39·99)	6,263·02 (3·60)	5,499·57 (35·16)	8,461·96 (54·10)	(—)2,962·39 (—)(18·94)
50 and above	55,770·07 (27·36)	49,725·76 (24·39)	6,044·31 (2·97)	2,397·14 (42·14)	1,875·43 (32·97)	521·71 (9·17)
All farms	3,60,928·65 (50·31)	2,81,091·63 (39·18)	79,837·02 (11·13)	23,530·97 (53·59)	27,074·89 (61·66)	(—)3,543·92 (—)(8·07)

TABLE No. 7.13—*contd.*

	Irrigated (Total)			Barani		
	Output	Input	Net output	Output	Input	Net output
(1)	(8)	(9)	(10)	(11)	(12)	(13)
0—5	28,024·81 (162·69)	20,142·70 (116·93)	7,882·11 (45·76)	1,300·00 (135·27)	501·50 (52·18)	798·50 (83·09)
5—10	63,134·10 (89·58)	39,520·82 (56·08)	23,613·28 (33·50)	3,409·24 (43·79)	2,910·85 (37·39)	498·39 (6·40)
10—15	40,704·85 (65·55)	25,131·67 (40·47)	15,573·18 (25·08)	3,676·82 (36·99)	868·55 (8·74)	2,808·27 (28·25)
15—25	113,141·72 (53·26)	93,783·84 (44·15)	19,357·88 (9·11)	22,059·94 (21·76)	12,061·30 (11·90)	9,998·64 (9·86)
25—50	81,286·93 (42·90)	77,986·30 (41·16)	3,300·63 (1·74)	21,748·02 (19·30)	11,817·46 (10·49)	9,930·56 (8·81)
50 and above	58,167·21 (27·76)	51,601·19 (24·62)	6,566·02 (3·13)	2,602·81 (13·72)	2,036·47 (10·73)	566·34 (2·99)
All farms	3,84,459·62 (50·50)	3,08,166·52 (40·48)	76,293·10 (10·02)	54,796·83 (21·77)	30,196·13 (12·00)	24,600·70 (9·77)

Note.—Figure in brackets represents average value per acre.

changed except for those in the lowest size group of 0-5 acres. These farms now show a surplus of Rs. 44 per acre which is comparable to the average return of corresponding farms in the perennial zone.

Farm Business

4.0. The farm business situation as a whole may now be summed up. The aggregates of output, input and net output, that is, for the crop and livestock enterprises jointly are reproduced in Table Nos. 7.14 and 7.15 to correspond to basis 'A' and 'B' estimates respectively. Net output computed on basis 'A' provides a full measure of net farm income or more commonly profit or loss. This measure is in conformity with accepted concepts in farm management analysis and allows for all the inputs including an imputed value for the labour of the farmer and members of his family. It will be seen from the Table that net returns on an average amount to Rs. 21.2 per acre in the commanded zone as against Rs. 14.2 in the barani zone, that is, an increase of 49.3 per cent with irrigation. A break up of the figure of net return suggests, that the impact of irrigation has been mainly in terms of additional crop production. Between different holdings, those in the largest size group have registered maximum profits per acre followed by holdings in the size group 10 to 15 acres and 25 to 50 acres which are similarly placed in this respect. On the other hand, in the barani zone maximum profits are observed in respect of holdings in the size group 10-15 acres followed by those in the size group 25 to 50 acres. Small farms in both the zones of study have recorded the maximum outputs per acre. Even so, it is in this group, especially in the commanded zone, that the maximum net loss of Rs. 93 per acre, is also observed. This is mainly due to the very intensive character of farming in this category of holdings. Farms in the next higher size group, however, break even, which is true of both the commanded and uncommanded zones. Within the canal zone non-perennial farms show a net loss of Rs. 6 per acre. Here farms in all the size groups with the exception of those in the last two categories have recorded losses varying from Rs. 36 per acre in size group 15 to 25 acres to a maximum of Rs. 202 per acre on farms in the size group 5 to 10 acres. These figures reflect the exceptional losses of crop production in this area in the year of inquiry.

4.1 The value of net output computed on basis 'B' which may be termed as farm business income is Rs. 54.7 per acre with irrigation and Rs. 33 per acre without irrigation. On an average this represents an increase of 65.7 per cent with irrigation. Apparently, the increased net output with exclusion of imputed inputs in the Barani zone is less as compared to corresponding increase in commanded zone which is suggestive, among other factors, of lower investment returns under conditions of dry farming. We had earlier in Chapter VI referred to this aspect. The increase in farm business income is most conspicuous in the case of very large holdings in the commanded zone. On the other hand, in the barani zone the maximum farm business income is observed on small farms of less than 5 acres.

TABLE NO. 7.14

Net output (in Rs.) from Farm Business (Basis A)

(Crop and livestock enterprises combined)

Size Group (Acres)	Perennial			Non-Perennial		
	Output	Input	Net output	Output	Input	Net output
(1)	(2)	(3)	(4)	(5)	(6)	(7)
0—5	50,812·68 (337·40)	64,208·75 (426·35)	(—)13,396·07 (—) (88·95)	9,111·71 (420·86)	11,735·06 (542·03)	(—)2,623·35 (—) (121·17)
5—10	1,83,571·12 (263·80)	1,81,725·30 (261·15)	1,845·82 (2·65)	2,254·73 (253·34)	4,049·34 (454·98)	(—)1,794·61 (—) (201·64)
10—15	1,34,014·06 (234·46)	1,15,812·59 (202·62)	18,201·48 (31·84)	9,129·85 (184·93)	12,494·86 (253·09)	(—)3,365·01 (—) (68·16)
15—25	4,46,250·14 (225·56)	4,14,777·66 (209·65)	31,472·48 (15·91)	29,008·46 (198·93)	34,320·14 (235·36)	(—)5,311·68 (—)(36·43)
25—50	3,79,317·90 (218·20)	3,37,208·75 (193·98)	42,109·15 (24·22)	28,023·82 (179·16)	27,305·78 (174·57)	718·04 (4·59)
50 and above	3,67,301·07 (180·16)	2,74,946·49 (134·86)	92,354·58 (45·30)	8,950·14 (157·35)	7,806·98 (137·25)	1,143·16 (20·10)
All farms	15,61,266·97 (217·64)	13,88,679·53 (193·58)	1,72,587·44 (24·06)	86,478·71 (196·97)	97,712·16 (222·56)	(—)11,233·45 (—) (25·59)

TABLE NO. 7.14—*contd.*

Size Group (Acres)	Irrigated (Total)			Barani		
	Output	Input	Net output	Output	Input	Net output
(1)	(8)	(9)	(10)	(11)	(12)	(13)
0–5	59,924·39 (347·89)	75,943·81 (440·89)	(—)16,019·42 (—) (93·00)	2,253·00 (234·44)	2,117·68 (220·36)	135·32 (14·08)
5—10	1,85,825·85 (263·67)	1,85,774·64 (263·60)	51·12 (0·07)	10,912·24 (140·17)	10,862·63 (139·53)	49·61 (0·64)
10—15	1,43,143·91 (230·53)	1,28,307·44 (206·64)	14,836·47 (23·89)	10,893·82 (109·58)	7,857·97 (79·04)	3,035·85 (30·54)
15—25	4,75,258·60 (223·73)	4,49,097·80 (211·41)	26,160·80 (12·32)	73,042·07 (72·05)	66,427·02 (65·52)	6,615·05 (6·53)
25—50	4,07,341·72 (214·97)	3,64,514·53 (192·37)	42,827·19 (22·60)	90,000·02 (79·88)	65,977·27 (58·56)	24,022·75 (21·32)
50 and above	3,76,251·21 (179·55)	2,82,753·47 (134·93)	93,497·74 (44·62)	11,825·31 (62·34)	9,983·46 (52·63)	1,841·85 (9·71
All farms	16,47,745·68 (216·45)	14,86,391·69 (195·25)	1,61,353·99 (21·20)	1,98,926·46 (79·03)	1,63,226·03 (64·85)	35,700·43 (14·18)

Note.—Figure in brackets represents average value per acre.

TABLE No. 7.15

Net output from Farm Business (Basis 'B')
(Crop and livestock enterprises combined)

Size Group (Acres)	Perennial			Non-Perennial		
	Output	Input	Net output	Output	Input	Net output
(1)	(2)	(3)	(4)	(5)	(6)	(7)
0—5	50,812·68 (337·40)	51,461·23 (341·71)	(—) 648·55 (—) (4·31)	9,111·71 (420·86)	9,170·46 (423·57)	(—) 58·75 (—) (2·71)
5—10	1,83,571·12 (263·80)	1,46,164·76 (210·05)	37,406·36 (53·75)	2,254·73 (253·34)	3,034·57 (340·96)	(—) 779·84 (—) (87·62)
10—15	1,34,014·06 (234·46)	91,734·08 (160·49)	42,279·98 (73·97)	9,129·85 (184·93)	9,396·99 (190·34)	(—) 267·14 (—) (5·41)
15—25	4,46,250·14 (225·56)	3,31,539·28 (167·58)	1,14,710·86 (57·98)	29,008·46 (198·93)	27,543·77 (188·89)	1,464·69 (10·04)
25—50	3,79,317·90 (218·20)	2,87,253·84 (165·24)	92,064·06 (52·96)	28,023·82 (179·16)	21,111·12 (134·97)	6,912·70 (44·19)
50 and above	3,67,301·07 (180·16)	2,45,750·58 (120·54)	1,21,550·49 (59·62)	8,950·14 (157·35)	7,036·21 (123·70)	1,913·93 (33·65)
All farms	15,61,266·97 (217·64)	11,53,903·77 (160·85)	4,07,363·20 (56·79)	86,478·71 (196·97)	77,293·12 (176·05)	9,185·59 (20·92)

TABLE No. 7.15—*contd.*

Size Group (Acres)	Irrigated (Total)			Barani		
	Output	Input	Net output	Output	Input	Net output
(1)	(8)	(9)	(10)	(11)	(12)	(13)
0–5	59,924·39 (347·89)	60,631·69 (352·00)	(—) 707·30 (—) (4·11)	2,253·00 (234·44)	1,693·59 (176·23)	559·41 (58·21)
5—10	1,85,825·85 (263·67)	1,49,199·33 (211·70)	36,626·52 (51·97)	10,912·24 (140·17)	8,554·88 (109·89)	2,357·36 (30·28)
10—15	1,43,143·91 (230·53)	1,01,131·07 (162·87)	42,012·84 (67·66)	10,893·82 (109·58)	5,815·77 (58·50)	5,078·05 (51·08)
15—25	4,75,258·60 (223·73)	3,59,083·05 (169·04)	1,16,175·55 (54·69)	73,042·07 (72·05)	45,396·16 (44·78)	27,645·91 (27·27)
25—50	4,07,341·72 (214·97)	3,08,364·96 (162·74)	98,976·76 (52·23)	90,000·02 (79·88)	47,395·43 (42·07)	42,604·59 (37·81)
50 and above	3,76,251·21 (179·55)	2,52,786·79 (120·63)	1,23,464,42 (58·92)	11,825·31 (62·34)	6,876·73 (36·25)	4,948·58 (26·09)
All farms	10,47,745·68 (216·45)	12,31,196·89 (161·73)	4,16,548·79 (54·72)	1,98,926·46 (79·03)	1,15,732·56 (45·98)	83,193.90 (33.05)

NOTE.—Figure in brackets represent average value per acre.

Family Labour and Farm Business Income

4.2. There are different methods of measuring farm incomes or the relative efficiency in farming. Returns to labour, labour earnings, earning on investment, net farm output and social income are among the many key indices used in farm management analysis. For the purpose of present study, however, where we are concerned with the total effect on farm business, the main indices of 'family labour income' and 'farm business income' need only be used. These are, of course, additional to the main indicator of 'Net output' which is the residual value of output after all expenses are deducted. These estimates have already been presented in earlier tables. For the sake of comparison the different indicators are brought together in Table No. 7.16. Considering family labour income which corresponds to profit or loss derived on cost basis 'A' plus the wages to farmer's own labour and that of his family, in other words, what the farmer and his family receive for their management, risk and physical labour, it would be seen that such income with irrigation is higher by about 29 per cent. Except for small holdings, all other farms in the commanded zone show higher family labour incomes than corresponding holdings in the barani zone. The maximum increase is observed in respect of very large holdings in the commanded zone where it is twice as large with irrigation as without. [1] On the contrary, in the small holdings there is a negative income of Rs. 16.3 in the commanded zone while in the un-commanded zone the farms show a positive return of Rs. 49 per acre. This is mainly an index of predominence of family labour in small farms in the Barani zone.

4.3. The last two columns of Table 7.16 give measure of farm business income which is identical with net output estimated on cost basis 'B'. This is obtained by adding to the family labour income, the unpaid interest on own capital and rental value of owned land. In this respect, it will be observed that farm business income is 65.2 per cent higher with irrigation, that is, Rs. 54.7 per acre in the commanded zone as against Rs. 33.1 per acre in the Barani zone. Evidently, the increase in the Barani zone with the addition of investment returns is very little which is a reflection of the lower investment in these farms. In the non-perennial zone, farms in the first size group again show negative returns. It is of interest, however, to observe that increase in farm business income with irrigation is most significant in the size groups 5-10 acres and over 50 acres and to a lesser extent in the size group 15-25 acres.

Total receipts

5.0 In the foregoing farm accounts, credit was taken only of value of crops and livestock production on the side of farm output. Together these account for more than 90 per cent of farm income. There are besides supplementary earnings mostly in terms of wages earned by the farmer and his family from work on other farms both within and outside the village. Tables No.

TABLE No. 7.16

Family Labour Income and Farm Business Income (in Rs.)

Size Group (Acres)	Net output on Basis 'A'		Wages of family labour		Total Family Labour Income		Unpaid interest and rent		Total Farm Business Income on basis 'B'	
	Irrigated	Barani	Irrigated	Barani	Irrigated (col 2+4)	Barani (col. 3+5)	Irrigated	Barani	Irrigated (Col. 6+8)	Barani (col 7+9)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
0—5	(—)16,019·42	135·32	13,213·61	337·71	(—)2,803·81	473·03	2,096·51	86·38	(—) 707·30	559·41
	(—) (93·00)	(14·08)	(76·72)	(35·14)	(—) (16·28)	(49·22)	(12·17)	(8·99)	(—) (4·11)	(58·21)
5—10	51·21	49·61	29,227·97	1,957·28	29,279·18	2,006·89	7,347·34	350·47	36,626·52	2,357·36
	(0·07)	(0·64)	(41·47)	(25·14)	(41·54)	(25·78)	(10·42)	(4·51)	(51·96)	(30·28)
10—15	14,836·47	3,035·85	21,861·82	1,719·14	36,698·29	4,754·99	5,314·55	323·06	42,012·84	5,078·05
	(23·89)	(30·54)	(35·21)	(17·29)	(59·10)	(47·83)	(8·56)	(3·25)	(67·66)	(51·08)
15—25	26,160·80	6,615·05	69,428·96	18,785·47	95,589·76	25,400·52	20,585.79	2,245·39	1,16,175·55	27,645·91
	(12·32)	(6·53)	(32·69)	(18·52)	(45·00)	(25·05)	(9·69)	(2·21)	(54·69)	(27·27)
25—50	42,827·19	24,022·75	36,134·93	16,323·45	78,962·12	40,346·20	20,014·64	2,258·39	98,975·76	42,604·59
	(22·60)	(21·32)	(19·07)	(14·49)	(41·67)	(35·81)	(10·57)	(2·00)	(52·24)	(37·81)
50 and above	93,497·74	1,841·85	11,644·48	2,803·31	1,05,142·22	4,645·16	18,322·20	303·42	1,23,464·42	4,948·58
	(44·02)	(9·71)	(5·55)	(14·78)	(50·17)	(24·49)	(8·74)	(1·60)	(58·91)	(26·09)
All farms	1,61,353·99	35,700·43	1,81,513·77	41,926·36	3,42,897·79	77,626·79	73,681·03	5,567·11	4,16,548·79	83,193·90
	(21·20)	(14·18)	(23·85)	(16·66)	(45·05)	(30·84)	(9·67)	(2·21)	(54·71)	(33·05)

Note.—Figure in brackets represent average value per acre.

7.17 and 7.18 show the distribution of total receipts or gross earnings under these items. The figures reflect the predominence of crop receipts, although respective proportions to total income of the farmer vary between the two zones and even more so, between different farm groups. Crop receipts account for more than 73 per cent of the total earnings in the commanded zone as against 68 per cent in the Barani zone (Table No. 7.18). Correspondingly, therefore, livestock receipts are higher in the barani zone. It is to be noted that percentage contribution to total income and value per acre of livestock production is the highest in the case of small farms, that is, less than 5 acres both in the irrigated and barani zones. Particularly, in the latter area such income is the principal source of earnings and considerably exceeds crop receipts both in absolute terms and in proportion to the total. In general, both livestock and crop produce declines with the increase in the size of the farm. Income from other sources is proportionately less in the irrigated zone, although in absolute value such income is about the same in both the zones of study. It will be seen that these receipts are more pronounced in the case of small farms. On the whole, the proportion of such income is higher in the barani zone which is true of all the farm groups with the exception of very large holdings. It would thus appear that in respect of small farms the relative contributions of farm and other receipts are fairly the same and are not affected by the factor of irrigation. The small farmers do not produce enough so as to give an adequate income to support their family and, therefore, there is need for supplementing their earnings from land. The other significant point of difference to note is that while in the irrigated zone supplementary earnings from other sources decline quite sharply in larger farms, similar feature is not observed in the case of holdings in the barani zone.

Extent of Monetisation

6.0. Monetisation is symbolic of economic progress in as much as greater use of cash for transactions marks an advance from the stage of self-sufficiency and possibly stagnance of agriculture. It depends on a number of factors such as land tenure, crop pattern, systems of wage payments, proximity to urban areas and marketing facilities, state of communications etc. In an area which is characterised by fairly self-sufficient economy, monetisation is not likely to be significant. Further, within a particular area differences between the more prosperous and the less prosperous farms may not also have equal bearing on the extent of monetisation. It is conceivable that under conditions of uncertain agriculture and financial duress, the farmer is compelled to sell a greater part of harvested produce to the exclusion of some of his own needs and subsequently buys back the various goods and services required in farm operations. Higher cash outlays in relation to total cost in such a case need not necessarily reflect a condition of stable or progressive agriculture. From the data regarding cash inputs as available from farm business survey in the Gang canal area, it is seen that the percentage of cost outlay to total cost is about the same in the project and

TABLE NO. 7.17

Total receipts (farm and non-farm)

(Rs. per acre)

Size group (Acres)	Irrigated						Barani					
	Farm receipts				Non-farm receipts	Total receipts	Farm receipts				Non-farm receipts	Total receipts
	Crop Produce	Live-stock	Other receipts	Total Farm receipts			Crop produce	Live-stock	Other receipts	Total farm receipts		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
0—5	179	171	4	354	55	409	96	142	3	241	42	283
5—10	173	97	2	272	16	288	96	46	—	142	17	159
10—15	162	70	3	235	11	246	73	37	—	110	10	120
15—25	169	56	1	226	5	231	50	22	—	72	8	80
25—50	171	46	2	219	—	219	60	20	—	80	1	81
50 and above	152	30	—	182	—	182	49	14	—	63	—	63
All farms	165	54	1	220	5	225	57	22	—	78	5	84

TABLE No. 7.18

Total receipts (farm and non-farm)

(Percentage distribution)

Size group (Acres)	Irrigated						Barani					
	Farm receipts						Farm receipts					
	Crop Produce	Live-Stock	Other receipts	Total Farm receipts	Non-farm receipts	Total receipts	Crop produce	Live-Stock	Other farm receipts	Total farm receipts	Non-farm receipts	Total receipts
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
0—5	43·8	41·8	0·9	86·5	13·5	100·0	33·9	50·2	1·0	85·1	14·9	100·0
5—10	60·0	33·7	0·8	94·5	5·5	100·0	60·4	28·9	—	89·3	10·7	100·0
10—15	65·8	28·5	1·2	95·5	4·5	100·0	60·8	30·8	—	91·7	8·3	100·0
15—25	73·2	24·2	0·4	97·8	2·2	100·0	62·5	27·5	—	90·0	10·0	100·0
25—50	78·1	21·0	0·9	100·0	—	100·0	74·1	24·7	—	98·8	1·2	100·0
50 and above	83·5	16·5	—	100·0	—	100·0	77·8	22·2	—	100·0	—	100·0
All farms ..	73·4	24·0	0·4	97·8	2·2	100·0	67·8	26·2	—	94·0	6·0	100·0

TABLE NO. 7.19

Cash outlays under different inputs

(Rs. per acre)

Item	Perennial		Non-Perennial		Irrigated (Total)		Barani	
	Per Acre (Rs.)	Percentage	Per Acre (Rs.)	Percentage	Per Acre (Rs.)	Percentage	Per Acre (Rs.)	Percentage
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Wages	14·7	21·5	24·6	29·3	15·3	22·1	2·5	11·0
Seeds	4·8	7·1	3·1	3·7	4·7	6·9	5·7	25·3
Manures and Fertilizers	4·3	6·3	1·8	2·1	4·2	6·0	—	—
Fodder	25·5	37·4	38·5	45·9	26·3	38·0	10·0	44·2
Rent	4·0	5·8	3·8	4·5	4·0	5·7	0·8	3·5
Taxes	7·7	11·3	6·9	8·2	7·7	11·1	0·5	2·3
Interest	1·6	2·3	1·2	1·4	1·5	2·2	1·1	4·8
Miscellaneous expenses	5·6	8·2	4·1	4.9	5·6	8·0	2·0	8·9
Total	68·2	100·0	83·9	100·0	69·2	100·0	22·6	100·0
Cash outlay as per cent of total cost		46·0		55·4		46·0		47·2

Barani areas (Table No. 7.19). If any thing, the proportion of inputs is higher by one point in the barani zone. Bulk of the expenditure in the barani zone is accounted by the items of fodder and seeds which together constitute 70 per cent of total cash expenditure. Most of this again represents purchases from project farmers. On the other hand, the outlay on seeds relatively to total cost expenditure is low in the commanded zone. The project farmers rarely, if ever, procures the seeds from the market, this being met from the previous crop. The expenditure on livestock feed in the commanded zone is again mainly on concentrates. This constitutes a significant proportion in the non-perennial zone.

6.1. The picture is totally different when figures of actual expenditure per acre of cultivated area are considered. On an average the cash outlay per acre is over three times larger with irrigation. The difference is observed under all the inputs with the exception of seeds where cost inputs are higher in the barani zone. There is absolutely no expenditure on fertilizers in the uncommanded zone. It is also noteworthy that wage payments to farm labour is over six times larger with irrigation which is a measure of the indirect primary benefits of irrigation. Within the commanded zone again wage costs are highest on farms under non-perennial irrigation determined largely by the employment of contract labour for cotton cultivation here.

Ratio of output to input

7.0. The ratio of output to input is yet another useful concept in analysis of farm business. The net return from farming is conditioned by the response of output to the application of various inputs as also by the levels of costs per unit of input and price per unit of output. These are apart from extraneous factors like soil, climate etc. In a diminishing returns industry like agriculture, farm output would undoubtedly increase with additions to inputs although the rate of increase of output would differ at different intensity levels. Figures in Table No. 7.20 indicate the input output ratios for selected farm groups. In the calculation of these ratios combined values of crop and livestock produce as also inputs have been considered. Taking firstly ratio computed on cost basis 'A', it is seen that the input-output ratio works out to 1.11 in the irrigated zone as against 1.22 in the barani zone. In respect of farms in the size group 5-10 acres, the input-output ratio is the same in both the commanded and unçommanded zones. In the former zone the ratio increases with the size of the farm although a similar trend is not observed in the Barani zone. The ratio is considerably less on smaller holdings which have recorded highest average expenditure.

7.1 On cost assumption 'B', the input-output ratio works out to 1.33 in the irrigated zone and 1.71 in the barani zone. The more favourable input-output ratio in the uncommanded zone is observed in respect of all the sample farm groups. The more favourable ratio here as compared to earlier cost assumption is due to value of family labour. It will, however, be noted that on either cost basis, the net output or profit per acre is higher with

TABLE No. 7.20

Input-Output Ratio under different assumptions

Size group (Acres)	Basis 'A'				Basis 'B'			
	Irrigated		Barani		Irrigated		Barani	
	Net output (Rs.)	Ratio of output to input	Net output (Rs.)	Ratio of output to input	Net output (Rs.)	Ratio of output to input	Net output (Rs.)	Ratio of output to input
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
0—5	(—)93·0	0·80	14·1	1·06	(—)4·1	0·99	58·2	1·33
5—10	0·1	1·00	0·6	1·00	52·0	1·24	30·3	1·27
10—15	23·9	1·11	30·5	1·38	67·7	1·41	51·1	1·87
15—25	12·3	1·06	6·5	1·10	54·7	1·32	27·3	1·38
25—50	22·6	1·12	21·3	1·36	52·2	1·32	37·8	1·88
50 and above	44·6	1·33	9·7	1·19	58·9	1·48	26·1	1·71
All Farms ..	21·2	1·11	14·2	1·22	54·7	1·33	33·1	1·71

irrigation. The more advantageous input-output ratio indicated in the uncommanded zone may be explained as due to the exceptional crop yields in the year of reference and very low inputs relatively to irrigated farms which also suffered some crop damage. Besides, as noted earlier, the method of evaluation of family labour adopted in the study has under-rated an important element of cost in the barani zone. It would be more fruitful to analyse production function on the basis of output and input data for individual crops preferably over a period of time.

Resume

8.0. In the foregoing analysis of farm costs and returns, we have attempted to describe the more important aspects of irrigated agriculture. The aggregates for the sample farms presented in Table No. 7.21 indicate the direction and magnitude of change in farm economy that may be associated with canal irrigation. While consideration of absolute values is hardly meaningful in sample investigations of this type the present study shows that irrigation from a major source such as Gang Canal has helped to realise additional crop production to the extent of Rs. 108 per acre, nearly three-fold increase. Even with increase that is in production expenses the project farmers reap profit of Rs. 13 per acre or an increase of 144 per cent in the net incomes over the level that they would obtain in the absence of irrigation. Higher margins are left with the Project farmers because farm costs have not correspondingly increased with output.

8.1. The increased expenditure arising from irrigation may itself be considered as an index of irrigation benefit in its indirect aspect. The principal sources of such benefits are increased employment of farm labour, that is, in wage terms an increase of over 650 per cent, increased expenditure on materials as seeds and fertilizers, to an extent of over 290 per cent and higher returns to State and Local authorities, to an extent of over 600 per cent. It is clear that the higher outlay on farm labour consequent on irrigation produces considerable secondary effects within the commanded area. The immediate impact is on the unemployed or under-employed farm labour in the neighbourhood of the project. Besides the above, benefits through expenditure on material inputs and farm perquisites accrue to the producing areas outside the project area. The larger demand, thus, increases the profits of the local traders and their turnover. The effects may not be so significant in respect of farm yard purchases since, these will increase the incomes of the adjacent Barani farmers. Likewise, the higher expenditure on seeds and livestock feed may not have appreciable effects on secondary and tertiary activities to the extent that such expenses mainly represent outlays in kind which are met from within the current farm business. These are, thus, not likely to have any significant impact on the rest of the economy.

8.2. The State and local authorities again obtain additional revenues largely through increase in land revenue collections. This aspect is referred to in greater detail in the last chapter. It is pertinent, however, to observe

TABLE No. 7.21

Primary benefits of Irrigation

Item	Irrigated		Barani		Difference	
	Rs.	Per acre	Rs.	Per acre	Rs.	Per acre
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1. *Direct benefit* :						
(*i*) Gross income (crop)	12,63,286	165·9	1,44,130	57·3	11,19,156	108·6
(*ii*) Net farm income (crop)@	1,68,150	22·1	23,472	9·3	1,44,678	12·8
2. *Indirect benefits:*—*						
(*i*) Paid Wages to labour	1,33,761	17·6	7,693	3·1	1,26,068	14·5
(*ii*) Bullock labour	3,45,328	45·4	41,381	20·3	2,94,146	25·1
(*iii*) Taxes (land revenue and cesses)	22,974	3·0	1,306	0·5	21,668	2·5
(*iv*) Materials consumed (seeds Fertilizers etc.)	1,47,780	19·4	16,619	6·6	1,31,161	12·8
(*v*) Rent and Interest	93,519	12·3	6,345	2·5	87,174	9·8

@Net Income : Gross Income minus all expenses on basis 'A' less water charges.

*Selected inputs only.

here that the larger returns to Government are a reflection of increased returns from various enterprises as also increased property values. Among other items rents and interest accrue to landlords and financiers of agricultural operations majority of whom reside within the colony. To sum up, it might be said that canal irrigation has not only improved farm business in the colony but diversified it as well. Farm incomes have more than doubled with irrigation and work opportunities have also increased considerably. To an equally significant extent, irrigation has increased the incomes of those that provide goods and services to the farm community, an aspect to which we will revert later. It is important to note, however, that these benefits have been rendered possible as much by the enterprise of the project farmers as by their investment. The latter is an important determinant considering that the investment income estimated as the profits in farm business plus the return to farmer's own capital is double, or over Rs. 22 per acre in the project area as against Rs. 11 in the uncommanded area.

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CHAPTER VIII

AGRICULTURAL LABOUR

1.0. The development of irrigated agriculture rests upon the existence and continued maintenance of an abundant supply of farm labour. The relatively larger proportion of population in the project villages which is dependent on wage labour is a measure of the demand for such services arising from irrigation.

The increased supply of farm labour in irrigated area creates many special conditions in the rural economy which require to be studied. A special enquiry concerning agricultural labour was, therefore, carried out to supplement the data on employment aspects gathered in the farm business survey. The more important facts about labour sought to be studied in the enquiry were (i) the source of supply of labour, (ii) days worked and stability in employment, (iii) earnings and other aspects as indebtedness etc. For this purpose, conditions of labour resident in project villages and working mainly on project farms were compared with those in the control villages.

The Sample

1.1. A total of 257 farm workers formed the sample which was distributed as follows : 243 in the project and 14 in the control villages.(¹) This was roughly one sixth of the households in the sample villages. The details of sample by type of labour and main zones of study may be seen in the Table below :

TABLE NO. 8.0

Number of Sample Units

Zone	Permanent		Casual		Total	
	No.	Per cent	No.	Per cent	No.	Per cent
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Irrigated						
Ganganagar/Padampur	84	71·2	90	72·0	174	71·6
Anupgarh	34	28·8	35	28·0	69	28·4
TOTAL Irrigated	118	100	125	100	243	100
Barani	4		10		14	

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(1) The classification of worker is based on the consideration that he has obtained major proportion of his income through wage services.

1.2 The labour consists of two principal categories (1) the permanent farm servant or 'Siri' who is attached to a farm usually for a period of one year and (2) the casual or unattached worker who undertakes all farm jobs on a daily or piece rate basis. Under conditions of dry farming, the labour of the farmer and of other members of his family is adequate to cope with the requirements of farm operations. Except, therefore, on very large farms, Siris are not employed on Barani farms and empolyment of casual labour is the general rule. This is reflected in the above figures which bring out that while the distribution of the casual and the permanent workers in the project area is more even (51 per cent and 49 per cent respectively), casual labour is considerably more in the Barani villages. Considering both types of labour, it has been observed that there are on an average 19 labour families per village in the project area as against 6 in the uncommanded area, even though the total number of households is much larger in the uncommanded villages. The extremely small number of labour households reflect the scarce and uncertain demand for wage labour in the Barani area. These few labourers, too, find employment largely in the adjacent irrigated villages.

1.3. The most conspicuous concentration of labour is seen in the neighbourhood of Ganganagar where 72 per cent of the sample is located. In this area, the proportion of casual or unattached labour also is greater while in the Anupgarh area located at the tail and of the canal, both types of labour are more equally distributed.

Structure of family : Earners and non-earners

2.0 The average family is slightly smaller in Barani villages and the number of earners also is less. For instance, the earning members are about 94 per cent of the adult male population of sample house holds in the irrigated villages while in the control villages the proportion is less or 80 per cent (Table No. 8.1). This refers only to adult male members in the family who are working. The female members of household also work on the farms mainly on such tasks as tending of livestock, weeding and harvesting of crops but such employment is neither continuous nor substantial. It supplements the income of the family rather than provide the chief source of sustenance. It is of interest to note that a large proportion of contract labour is of female labour engaged extensively on operations like cotton picking. This is an outcome of irrigation and in areas like Ganganagar and Padampur with extensive cotton acreage, the additional farm employment available in this form is considerable.

TABLE No. 8.1

Particulars of family size and earners in selected households

Particulars	Irrigated	Barani
(1)	(2)	(3)
1. Sample households	243	14
2. Total persons	1,180	58

TABLE NO. 8.1—*contd.*

(1)	(2)	(3)
Adults		
(*i*) Males	348	20
(*ii*) Females	293	14
Sub-Total	641	34
Children		
(*i*) Males	296	13
(*ii*) Females	243	11
Sub-Total	539	24
3. Number of earners	327	16
4. Per cent of earners	94	80

Migrant Labour

3.0. The additional labour requirements are normally met by engaging labour from within the village. Where, however, labour is scarce, it has to be drawn from adjacent areas. An analysis by place of residence of sample workers shows that a great majority of them (71 per cent) migrated to the project area in search of employment (Table No. 82). This does not include persons who had moved to the colony from other tehsils and parts of the District. Most of them (95 per cent) had migrated from the State of Punjab. As the colonists themselves were largely from Punjab, they had naturally drawn their labour supply also from that State. Frequently, it is the Siri who follows the master to the newly purchased land in the colony. An enquiry into their past occupations also revealed that except for about 14 per cent if the workers who earlier had some land or were cultivating either in their own right or as tenants, the large majority of them were mainly following the same occupation (Table No. 8.2). The occupational shift if any, is thus not significant. The migrants were largely attracted by prospects of better and secure employment, both of which had been facilitated by irrigated farming.

TABLE NO. 8.2

Number of imigrants and particulars of past occupation

Particulars	Irrigated	Barani
1. Sample workers	243	14
2. Migrant workers	172	2
3. Percent of 2 to 1	70·8	14·3
4. *Past occupation* :		
(*i*) Mainly same	205 (84·4)	14 (100·0)
(*ii*) Mainly cultivation	35 (14.4)	— —
(*iii*) Other occupations	3 (1·2)	— –
TOTAL	243 (100·0)	14 (100·0)

The permanent farm Servant

4.0. Table No. 8.3 gives figures of days worked and wages earned separately for permanent and casual labour. In respect of permanent farm servants who are employed largely on the farm itself and who are rarely permitted to work on other farms or take up non-farm jobs, there would obviously be no earnings reported under such sources. While the small size of the sample in the Barani area renders a proper comparison of this category of labour in project and Barani areas difficult, it is noticeable that the average employment is comparable in both the areas. The average earnings are also comparable in both the areas or Rs. 725 in the project area against Rs. 732 in the Barani area. There is thus no significant difference in overage earnings per day. While irrigation through increased demand for permanent farm labour would widen the scope for employment of such labour, it does not appear to affect the level of wages or the earnings of such labour which are normally fixed by custom. Except where the 'Siris' share the crop (in such cases, however, the value of wages would be higher because of the higher yield of crops), their earnings in irrigated area are not higher than in the Barani area.

4.1. The only notable difference is that the 'Siris' in the canal zone are paid more in cash while those on the Barani farms receive more in kind. In the former case, the increased cash payments could involve greater remittances to their families and relatives in the punjab. We have not attempted to estimate the quantum of such remittances but as most of them reside with their families in the chaks, it is unlikely that such remittances are appreciable.

TABLE No. 8.3

Number of days worked and wages earned

Particulars	Permanent		Casual	
	Irrigated	Barani	Irrigated	Barani
(1)	(2)	(3)	(4)	(5)
1. No. of workers	118	4	125	10
2. *Days worked* :				
(*i*) Within the village	40,127	730	21,620	754
	(98·33)	(50·45)	(90·03)	(52·11)
(*ii*) Outside the village	680	717	2,395	693
	(1·67)	(49·55)	(9·97)	(47·98)
TOTAL (Days)	40,807	1,447	24,015	1,447
	(100·00)	(100·00)	(100·00)	(100·00)
3. Average days worked	345·8	361·7	192·1	144·7
4. Wage receipts :				
(*i*) In cash	56,268,75	1,600·00	41,626·39	2,618·00
	(65·80)	(54·64)	(74·82)	(69·75)
(*ii*) In kind	29,249·75	1,328·00	14,006·44	1,135·50
	(34·20)	(45·36)	(25·18)	(30·25)
TOTAL (Rs.)	85,518·50	2,928·00	55,632·83	3,753·50
	(100·00)	(100·00)	(100·00)	(100·00)

Note.—(*i*) Figures in brackets under days worked are percentages to total days worked.

(*ii*) Figures in brackets under cash and kind payments are percentages to total wages.

Employment and earnings of casual labour

4.2. In the case of casual labour, figure in above Table suggest that in the project area the total mandays amount to 24,015 days or on an average, 192 days in the year. Further greater work opportunities are available during Rabi (November-May) when, on an average, a farm worker may find employment for about 115 days. In the Kharif period, however, he has work for only about 77 days. On the other hand, in the Barani villages, total employment reported works out to 1,447 man-days or on an average 145 days in a year. It could, therefore, be inferred that with irrigation employment was higher by about 32 per cent. The extent of employment would be even larger if figures of working days within the village were compared. Indeed the colony labour rarely move to other villages in search of work while those in the Barani villages frequently do so. Nearly half the time (48 per cent of working days) labour in Barani village has to move to other villages mostly in the commanded area. Intensive farming through irrigation is an important factor in drawing larger supplies of farm labour from adjacent non-project villages.

4.3. If a person working for about 300 days in the year is considered as fully employed, it would be seen from Table No. 8.4 that only the Siris are fully employed(2). In the case of casual labour on the other hand, it is found that while they are rarely fully employed, in the irrigated area nearly 80 per cent of the workers are employed for periods varying from 150 to 300 days in the Barani villages, an equal proportion of the workers find work for periods varying from 100 to 250 days. From a different angle, it would be noticed that while about 5 per cent of the farm labour is without any employment for nearly two thirds of the year, in the absence of irrigation 20 per cent remain unemployed for the same period. In irrigated farming, there are thus more workers employed for longer time. This is significant despite the limited sample in the control group of villages.

TABLE NO. 8.4

Distribution of labour and average earnings by different working periods

Days worked	Permanent				Casual			
	Irrigated		Barani		Irrigated		Barani	
	No.	Average earnings	No.	Average earnings	No.	Average earnings	No.	Average earnings
Over 300	113	735	4	732	—	—	—	—
250—300	3	452	—	—	10	578	—	—
200—250	1	464	—	—	50	532	1	500
150—200	—	—	—	—	40	410	3	527
100—150	1	660	—	—	19	288	4	304
Less than 100	—	—	—	—	6	230	2	229
TOTAL	118	725	4	732	125	445	10	375

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(2) This is exclusive of weekly and other holidays. In rural employment analysis, there is actually no standard and acceptable concept of full employment. The above criterion is adopted only as working basis.

Days worked

4.4. A further break-down of employment by days worked each month during the Rabi season may be seen in Table No. 8.5. In an inquiry as this, where the employment data are gathered in one intensive round, it is not an easy task to obtain precise figures especially where the reference period covers a full agricultural year. For a more meaningful analysis, it is advisable to limit observation to a crop season. It will be seen from the figures in the Table that during Rabi the employment is a little more in the project area particularly considering the work done within the project villages. There is relatively less work in the project area during the months January and February while in the uncommanded villages work opportunities are apparently lean during a greater part of the season *e.g.*, December through March. The peak employment is, however, observed in the month of April followed by May coinciding with the harvest operations. In general, farm labour in the project area works for about 54 per cent of the days during the Rabi season as against 46 per cent in the uncommanded villages. Even in the kharif season there is larger demand for farm labour in the project area. The percentage of sample workers not reporting any work was observed to vary from 1.6 per cent in the peak month of April to 8 per cent during May that is, after the harvesting of Rabi crops in the project area. The percentage of such workers in the Barani villages varied between 10 to 30.

TABLE NO. 8.5

Days worked (month-wise)*

Month	Irrigated		Barani	
	Within Village	Other Villages	Within Village	Other Villages
(1)	(2)	(3)	(4)	(5)
November	15	9	7	17
December	15	10	9	10
January	14	10	8	10
February	12	9	10	12
March	17	13	7	17
April	20	10	23	20
May	19	11	15	14
Average (Monthly)	16	10	17	14

*Average per worker.

4.5 The percentage of labour unemployed was observed to vary from about 1.6 per cent in April to a maximum of about 8 per cent in May that is after the harvest of Rabi in the project area. On the other hand, in the Barani area the percentage of such persons varied between 10 to 30 per cent of the sample.

Earnings per worker and family income

5.0. With greater work opportunities available in the irrigated area, wage earnings are also higher. During Rabi the average earnings per worker amount to Rs. 287 in the irrigated area as against Rs. 241 in the Barani villages. In other words, the wage income is 15 per cent higher with irrigation. The earnings are also higher during the Kharif season when cultivation is fairly precarious in the Barani area. Taking the year as a whole, the wages of labour on irrigated farms seems to be 19 per cent higher or Rs. 445 with irrigation and Rs. 375 without it. The higher earnings are merely indicative of the larger number of working days of project labour and not necessarily of higher wage rates. Actually, the average daily earnings during Rabi in irrigated and Barani villages amount to Rs. 2.50 and Rs. 2.80 respectively. In the Kharif period as well, a labourer in Barani area gets a daily wage of 2.30 while his counter part in the project village earns Rs. 2.05. The systems of wage payments are similar in both the areas except, that the casual worker in the project area receives slightly more in cash payments (Table No. 8.6).

TABLE NO. 8.6

Earnings of agricultural labour

	Rabi		Kharif		Annual	
	Rs.	Per cent	Rs.	Per cent	Rs.	Per cent
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Irrigated :						
Cash	24,761·00	69·1	16,865·39	85·1	41,626·39	74·8
Kind	11,052·19	30·9	2,954·25	14·9	14,006·44	25·0
TOTAL ..	35,813·19	100·0	19,819·64	100·0	55,632·83	100·0
Barani :						
Cash	1,570·00	65·1	1,048·00	78·2	2,618·00	69·7
Kind	843·00	34·9	292·50	21·8	1,135·50	30·3
TOTAL ..	2,413·00	100·0	1,340·00	100·0	3,735·50	100·0

5.1. Not only are per capita earnings higher in the irrigated villages but the average family income also is higher, being Rs. 834 per household or 56 per cent more than in the uncommanded villages. This difference is found in almost all the items constituting the family income that is wages earned by the chief bread-winner in the family, the earnings of other members and miscellaneous receipts from subsidiary occupations etc. In per capita terms, the income is Rs. 165 in the project as against Rs. 114 in the barani area. No significant difference, however, has been observed in the family incomes of permanent farm servants.

Indebtedness : conclusion

6.0. Some supplementary information regarding indebtedness was also gathered during the survey. Of the 14 workers interviewed in the Barani villages not a single worker reported any debt! This is partly due to inability to provide security for raising a loan. In the irrigated area, on the other hand, about 9 per cent of the Siris reported indebtedness with an average debt of Rs. 428. Also 31 per cent of casual workers reported indebtedness with an average debt of Rs. 401. The principal reasons for debt reported were domestic need and ceremonies. The greater part of the reported debt was also contracted before migration to the colony.

6.1. In conclusion it may be stated that the Gang canal has made possible maintenance of a large body of wage labour at a level of earnings higher than what could possibly obtain under dry farming conditions. Work opportunities have increased considerably and correspondingly individual and family incomes. There is reason to believe that the actual divergence in the two samples would be appreciably larger and significant than what the foregoing figures would suggest, if in the control group of labour only that labour which is exclusively employed in unirrigated villages is included. Two serious limitations of this analysis to be borne in mind, are the wide disparity in size of sample and the fact that the sample workers in the control group have also partially benefitted from irrigation. The conclusions given above thus err on the side of caution with regard to the beneficial effects of irrigation.

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CHAPTER IX

SECONDARY BENEFITS—INDUSTRY

Secondary benefits of irrigation

1.0. Evaluation of the wider effects of irrigation which may be termed secondary benefits (or indirect) is an extremely complex task. Considerable difference of opinion, particularly in the U.S.A., has developed around concepts underlying measurement of such benefits, if not on the basic question of inclusion of these in an overall assessment of irrigation projects. There is, however general agreement on the identification of such benefits. One of the oft-quoted authorities, for instance, has defined these benefits as the values added by transporting, processing and distributing the added farm products from the project plus any value added by other activities 'stemming' from or 'induced' by the project(1). To illustrate, the value of bread over and above its wheat content would provide a gross measure of the off-farm (processing) benefits. The difference under conditions of irrigation could thus be attributed to the project under study. This, however, is an over-simplification of the issue and overlooks a host of problems of methodological significance. It is hardly necessary to examine this aspect in detail for the purposes of present study. The measurement problems in this field being as yet unresolved, an attempt could at best be made to present the differences in secondary and tertiary activities in the project and non-project areas.

1.1. For the purposes of present study, the Committee of Direction, suggested that the secondary benefits should be studied in relation to the primary benefits of a project and in terms of additional values created in processing, trading and transporting activities. A general study of the economy of the area would be supplemented by case studies of a limited number of establishments which were numerious and important in the area. Selection of such establishments would be based on a census of activities in the selected areas of study. For this purpose, the Committee suggested a practical method of selection of areas of study in both the rural and urban areas depending primarily on their geographic location and the economic links which such areas had with the project. A comparative study of industrial and trading activities in the project and 'control' areas thus provides material for the study of secondary and tertiary benefits. In such a study, figures of output and cost help in making a fuller comparison of benefits to income receivers like labour as also returns to capital and management besides tax receipts to Governments. While such an analysis present benefit estimates in "gross" terms, another possible approach is by analysing figures of "net benefits". In the latter method, the "net output" of industries is apportioned to different factors of production in the same ratio as their cost to total. The share of net output credited to the farm products under processing may be designated as the "benefit factor" which when applied to toal value of farm products being processed provides a measure of net benefits arising from irrigation and accruing to the secondary activities.(2)

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(1) Report of the Sub-committee on benefits and costs: Federal Inter-agency River Basin Committee, Chapter IV.

Selection of study centres

2.0. Application of the above concepts to the Gang Canal area presented certain difficulties. As mentioned earlier, processing activity in the area was largely concentrated in the market towns or 'mandis'. Local processing being thus extremely limited, no useful enquiry with regard to rural processing industries was possible and the 'samples' were, therefore, drawn mainly from the market centres in the area. In the selection of the study centres, the principal criteria kept in view were that such centres or towns in the project area should draw a greater proportion of trade from adjacent irrigated village in terms of annual sales or purchases and should be focal points of traffic flows from the surrounding areas. Besides, they should also provide for the processing of the bulk of farm produce from neighbouring colony area and provide other requisite services to these farmers. In this respect, the farm business survey also was helpful in indicating the general direction of farm sales and trade. On this basis, Sriganganagar and Raisinghnagar were selected from the colony area for a study of industrial and trading activities. In addition, Padampur Mandi was also included in the project sample in view of the special concentration of industry in this small but growing market centre. Out-side the colony area, the town of Hanumangarh was selected for purpose of 'control' or to represent conditions in an area mainly dependent upon dry-land agriculture. A few details might be given regarding these centres.

2.1. The census of 1951 listed in all 11 urban centres in the District of which 7 were located in the canal colony. Of these, 3 "towns" had population less than 5,000 each but were classified as urban centres as they had population predominantly urban in character. For the purposes of the present study, towns which were close to the Indo-Pakistan border were eliminated. The frame thus being reduced, the scope of application of random methods of selection of towns became very limited and a purposive selection was, therefore. adopted. It may be mentioned that this method offered the advantage of making case studies of towns of dissimilar population and size. Except for Raisinghnagar in the project area which had fairly comparable population to that of the control town of Hanumangarh, the other project centres were very dissimilar in size. This was, however, unavoidable for selection of a comparable control centre or centres would have meant shifting the area of investigations to other districts of Rajasthan far removed from the project under study and would thus have affected the representative character of 'control' data. The district town of Sriganganagar could well be described as the gift of Gang Canal and thus had a special claim for inclusion in a study of this type. Padampur was included in view of the special concentration of industry. In a closely knit area like the tract under study where all the urban centres are fairly well connected, any division of centres into irrigation-based or otherwise would indeed contain an arbitrary element. In the case of Hanumangarh, for instance, it was observed that it had recently come within the orbit of the forces generated by the extension of the Bhakra Canal system. With the setting up of Bhakra Canal Offices here, retail trade in particular had received considerable impetus. To this extent, the comparability of results of our enquiry is affected, as the data for this centre would more appropriately illustrate conditions in initial stages of large public development. For purposes of study of benefits of industries, however, this peculiar situation is not expected to vitiate the main findings.

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(2) For a more detailed consideration of this method which is currently adoted by Bureau of Reclamation (U.S.A.), please see footnote on page 173.

2.2. After selection of towns for urban studies, a census of all the industrial and trading establishments in the selected centres was carried out. A total of 3,101 establishments were listed of which 1,241 were classified as industrial units and the rest as business establishments. The census gathered broad particulars of the establishments as location, power used, number of persons engaged etc. Before considering the more important aspects of industry a word of explanation of the classification of industry would be relevant.

TABLE NO. 9.0

Industrial units in selected centres

(Number and percentage distribution)

Industry Group	Project				Control
	Ganganagar	Padampur	Raisinghnagar	Total Project	
(1)	(2)	(3)	(4)	(5)	(6)
1. Processing ..	29 (3·6)	7 (8·8)	7 (4·0)	43 (4·0)	11 (6·4)
2. Engineering and Repair Services	119 (14·6)	12 (15·2)	25 (14·2)	156 (14·6)	26 (15·1)
3. Other Manufactures and Services	666 (81·8)	60 (76·0)	144 (81·8)	870 (81·4)	135 (78·5)
TOTAL ..	814 (100)	79 (100)	176 (100)	1,069 (100)	172 (100)

NOTE.—Figures in brackets represent percentage to totals.

Classification of units

3.0. Table No. 9.0 gives the overall distribution of the industrial units in the selected centres and by the principal groups. It will be seen that the units have been classified under 3 major groups viz., (1) processing (2) general engineering including repair services and (3) other manufactures and services(3). Of these 3 groups, the first *i.e.* processing is the most important from the point of view of measurement of secondry benefites of irrigation. It could be said that expansion of capacity in this sector is primarily dependent upon prosperity of agriculture brought about by secure irrigation. The term 'processing' is, however, used in a broad sense to denote mainly various types of units engaged in processing of agricultural produce e.g. flour milling, cotton ginning etc. Some of the units are purely servicing units such as flour mills which process for direct consumption. Others like cotton gins perform only one task in the elaborate manufacturing process; these units are in a sense producing semi-finished products for further processing in the larger undertakings located outside the area. The principal consideration in grouping together these units with somewhat dissimilar characteristics and functions is that their location as also other production economies are greatly affected by the proximity of irrigated agriculture. Indeed an undertaking like cotton in has a direct and determinate relationship with canal irrigation. This is also true, to a lesser extent, of such activities as oil crushing, flour milling, etc. These units are mainly resource-based unlike others which have less direct relationship with canal irrigation. It is from this point of view that the classification of the sample units under the specified groups becomes relevant. Under the major group 'processing', units have been further classified as flour mills, cotton gins etc. mainly on the basis of share of income under the specified category. It may be observed that almost all the units undertook in addition to their main functions, some other activities as well *e.g.* saw milling, oil crushing, ice-manufacture etc. For instance, most of the flour mills studied had in addition carding equipment and not infrequently an oil press. These installations meant little extra capital, although they were handy in supplementing the earnings of the undertakings. Besides it helped to provide more continuous employment.

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(3) The categorisation of units here is based on the probable relationship with irrigation. The first group *i.e.* processing which from the point of view of irrigation is most important includes units which correspond to the major groups 20, 23, 28 and 33 flour milling (20), cotton ginning (23), others *e.g.* saw milling etc. (28 and 33) under the industry Division 2-3 *i.e.* manufacturing in the ISI classification of industry and occupations. The second group corresponds to the major group 38 within the same Industry Division. The last group 'other manufactures' an ominibus category includes. Various consumer goods manufacturing and services. For instance, leather and foot wear industries as also brick kilns correspond to the major groups 31 and 34 of Division 2-3. Restaurants, confectioners and personal services correspond to the major group 83 of Division 8 while the last *i.e.* 'miscellaneous' services correspond to the major group 39 under Division 2-3.

3.1. The next group i.e. 'General engineering and repair services' include mainly auto and tractor servicing establishments, cycle repairs etc. The growth of these units need not generally be linked to the process of development under canal irrigation. But in this area, it was observed that a good number of these units were established to provide servicing facilities to tractors which were in considerable use in the colony area. The last group includes a wide variety of undertakings such as restaurants and confectioners, leather and foot wear industries, brick kilns, tailoring establishments, gold smithy etc. and other personal services as launderers, hair dressers etc. units which undertook part trading and part servicing functions. These units providing consumer services have a closer relationship with the size of population. In their case, development of irrigated agriculture, although providing an important condition, need not be an immediate cause since in their number and composition depends a good deal upon other factors such as the increase in population, and incomes, development of other social overheads as communications, transport and consumer's preferences etc.

General characteristics

4.0. From figures in Table No. 9.0 it is evident that there is considerable concentration of industry in the district town of Sriganganagar, a factor which is mainly determined by the larger size of population of this town (nearly five times as large as that of Hanumangarh) and consequent demand for various consumer services. This is especially true of units in the third group which proportionately are more numerous here as compared to Hanumangarh. In the first group, however, the distribution is more favourable in the 'control' centre. What is important to observe is that there are more industrial units in Raisinghnagar in the project area as against the 'control' town, although the population of the latter is larger. It would also be observed that the distribution of industrial units is identical in Sriganganagar and Raisinghnagar towns which otherwise are very different in size of population. In the case of Padampur, however, there are more of processing units (mainly flour mills) which compare favourably with other centres, both within and outside the project area. In general, both in the project and control centres the miscellaneous consumer services are the most significant group being respectively 81 and 79 per cent. Nearly half of these are restaurants and confectioners which have considerably increased in number in recent years more especially in Hanumangarh, a visible index of marked growth of population here.

4.1 A comparison of industrial units with reference to local population would be more meaningful. The main conclusion indicated by such a comparison is that, the distribution of industry in both the areas is not very dissimilar. (Table No. 9.1). The number of processing industries per 1,000 of local population, however, is higher in the control centre. Comparing centres with similar population size e.g. Raisinghnagar in the project area and Hanumangarh in the control area, there are relatively more of engineering and other consumer services in the former. The overall averages for the project area have been depressed primarily due to the relatively fewer establishments in Sriganganagar. These are related to local population. On comparing figures of population of tehsils, however, the above conclusion is reversed. Thus there are more industrial units in the project area in relation to population which is observed in all the groups. The most marked increase is in respect of consumer services. Some differences, are however discernible between different centres as also among different groups. The figures are expressed in relation to the tehsil or subdivision population since the selected centres are also tehsil towns and focal points of trading and processing activities of each sub-division.

TABLE No. 9.1

Number of Industrial Units (per 1,000 of population)

Centres	Processing		Engineering & Repairs		Others		Total	
	A	B	A	B	A	B	A	B
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Project:								
Ganganagar ..	0·8	0·2	3·3	1·0	18·3	5·0	22·3	6·1
Padampur ..	4·6	0·1	7·9	0·2	39·7	1·0	52·3	1·3
Raisinghnagar	1·4	0·2	5·0	0·6	28·2	3·3	34·5	4·0
TOTAL ..	1·0	0·2	3·6	0·7	20·2	3·7	24·8	4·6
Control:								
Hanumangarh	1·6	0·1	3·8	0·3	19·8	1·3	25·2	1·7

EXPLANATION.—'A' Indicates per 1,000 population of Centre.
'B' Indicates per 1,000 population of tehsil or sub-division.

4.2. Further classification of units by size group of invested capital indicates that most of the units in both areas of study are small or with capital less than Rs. 5,000. This is also true, if we relate the units to local population (Table No. 9.2). The ratios are comparable in both areas. In the second category, that is with capital range of Rs. 5,000 to 20,000. there are relatively more units per 1,000 persons in the project area. In the last as in the first category, there are more units in the control town. The distribution of units in each group, however, suggests the relatively greater number of units with capital of over Rs. 5,000 in the project centres. For a more detailed study of other aspects, we may turn to consideration of the data gathered in the intensive round.

TABLE NO. 9.2

Classification of Industrial Units according to Invested Capital

Size Group	Processing		Engineering & Repair Services		Other Mafg. and Services		Total	
	No.	Per 1000 Popln.	No.	Per 1000 Popln.	No.	Per 1000 Popln.	No.	Per 1000 Popln.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
(i) Up to Rs.—5000								
Project ..	17	0·39	133	3·06	829	19·07	979 (91·58)	22·52
Control ..	4	0·58	26	3·74	134	19·30	164 (95·36)	23·63
(ii) Rs. 5,000-20, 000								
Project ..	14	0·32	21	0·48	33	0·76	68 (6·36)	1·56
Control ..	2	0·29	—	—	1	0·14	3 (1·74)	0·43
(iii) Over Rs. 20,000								
Project ..	12	0·28	2	0·05	8	0·18	22 (2·06)	0·51
Control ..	5	0·72	—	—	—	—	5	0·72
			—	—	—	—	(2·9)	
Total Project ..	43	0·99	156	3·59	270	20·01	1,069 (100·00)	24·59
Control ..	11	1·59	26	3·74	135	19·44	172 (100·00)	24·77

NOTE.—Figs. in brackets in Col. (8) represent percentages.

Sampling

5.0. For drawing the intensive sample, the industrial units listed were classified according to the three groups i.e. processing, repair services and other manufactures and services. To facilitate a better representation, further stratification related to size of capital was made and three main divisions were designated as up to Rs. 5,000, Rs. 5,000 to 20,000 and over Rs. 20,000. There were very few units with a capital of over Rs. 1 lakh which have been dealt separately. The sampling design provided for random selection of units subject to a minimum sampling fraction of 15 per cent for processing group, 10 per cent for repair services and 5 per cent for other services. In the study, however, more samples were included particularly in the processing group on account of the restriction that a minimum of 2 units should be taken from each size-group to provide for any meaningful results Figures in Table No. 9.3 give the distribution of sample units under the main group as also the proportion to the total population or universe.

TABLE NO. 9.3

Number of Industrial units in the sample and percentage to total population

Industry Group	Project		Control	
	Selected Units (No.)	Percentage of Population	Selected Units (No.)	Percentage of Population
(1)	(2)	(3)	(4)	(5)
1. Processing	17	39·5	5	45·5
2. Engineering & Repairs ..	19	12·2	3	11·5
3. Others	53	6·1	9	6·7
TOTAL ..	89	8·3	17	9·9

Characteristics of the Sample

6.0. All the processing units in both the areas of study with the exception of one unit in the Project area use power. On the other hand, units in the third group (other consumer services) do not use power except for one in the Project area. In the second group 5 out of 19 units or 26 per cent in the project area are power-based while in the control area there is only one such concern. Electricity provides the chief motive force in the project area while most of the units located in the control centre use largely diesel-oils. The sample units are not comparable in all respects and within the group, there are variations in respect of size of capital, source of finance etc. By and large, the units sell their products to local consumers and households. Proportionately more enterprises in the project area are housed in rented premises that is 75 per cent of sample units here as against 65 per cent in Hanumangarh. This feature is more marked in the processing group. Greater part of the finances of these enterprises are provided by the owners themselves either individually or in partnership with others.

6.1. In subsequent analysis, indices on selected aspects have been expressed in relation to the average unit as also to local population (per thousand persons). Unit analysis is helpful in focussing attention on pronounced differences in size e.g. capital, output etc., which in the case of resource-based industries may be attributed, in the main, to the single factor of irrigation. Expressing the various economic characteristics of such units in terms of local population would be hardly meaningful except to the extent that such ratios might indirectly provide a broad comparison of the pattern of development. On the other hand, such comparisons acquire validity and significance in respect of units classified under the second and third groups which have correlation with the size of popluation and other determinents as income distribution etc.(4).

6.2. It would be observed from figures in Table No. 9.4. that the overall distribution of industrial units in relation to local population is comparable in both the project and control centres. There are, however, more processing units mainly flour mills in the control centre. The distribution of sample units closely corresponds to that of total establishments indicated in Table No. 9.1. It is noteworthy that two types of enterprises, i.e. textile units in the processing group and brick kilns under 'others' do not occur in the control area. While the first could not perhaps be established without irrigation, larger construction activity in the Project area is a reflection of the general urban expansion in the area. On the whole the generally comparable distribution in the 'control' area is a more recent phenomen and provided more recent estimates of population are available, this picture could well be different.

TABLE No. 9.4

Industrial Units (Per 1000 of population)

Industry Group	Project		Control	
	No. of Units	Per 1000 population	No. of Units	Per 1000 population
(1)	(2)	(3)	(4)	(5)
1. Processing :				
(*i*) Flour	9	0·53	4	1·29
(*ii*) Cotton ginning	3	0·18	—	—
(*iii*) Others	5	0·29	1	0·32
Sub TOTAL ..	17	1·00	5	1·61
2. Engineering and Repair services	19	3·62	3	3·82
3. Other Manufactures and Services:				
(*i*) Restaurants and Confectioners	23	8·76	4	8·73
(*ii*) Leather and Footwear ..	9	3·43	2	4·37
(*iii*) Brick Kilns	5	1·90	—	—
(*iv*) Personal services	9	3·43	1	2·18
(*v*) Miscellaneous	7	2·66	2	4·37
Sub TOTAL ..	53	20·18	9	19·65
GRAND TOTAL ..	89	24·91	17	25·12

(4) In relating the various characteristics to the local population, the total population of project centres (43,050) and that of Hanumangarh (6,837) were reduced for different groups by the sampling fractions of these groups. The assumption is, that the population reduced by the sampling fraction supports the sample establishments. From the population figures so adjusted, the ratios i.e. per thousands, of the population were worked out. This would ensure statistical comparability of the data especially as the sampling fractions for different groups as also between project and control areas were different.

7.0 Figures of value of investment show that the average investment per establishment is larger under all the three groups in the project area. The productive capital employed per unit is higher by about 28 per cent in the Project centres. (Table No. 9.5). The maximum increase per unit is observed in the second group under repair services and engineering units. A breakdown of capital into its principal components of fixed and working capital in percentage terms shows that the percentage value of fixed capital is higher among project units in the processing group (Table No. 9.6). In the other groups, however, the share of fixed capital is relatively larger among units in the control centre.

TABLE No. 9.5

Investment per unit and per worker

(In thousand Rupees)

Industry Group	Project				Control			
	No. of Units	Total investment	Average investment	Investment per worker	No. of Units	Total Investment	Average Investment	Investment per worker
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1. Processing ..	17	585·30	34·42	3·60	5	114·04	22·81	4·22
2. Engineering and Repair Services ..	19	127·13	6·69	2·12	3	4·77	1·59	0·79
3. Others ..	53	140·53	2·65	0·45	9	8·46	0·94	0·47
TOTAL	89	852·96	9·58	1·60	17	127·26	7·48	2·50

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TABLE No. 9.6

Capital Investment (Percentage distribution of fixed and working capital)

Particulars	Project				Control			
	Processing	Repair Services	Others	Total	Processing	Repair Services	Others	Total
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1. No. of units	17	19	53	89	5	3	9	17
2. Fixed capital :								
(*a*) Buildings ..	25·1	—	8·4	18·6	21·3	—	34·5	21·4
(*b*) Plant and equipment	41.5	91.4	26.4	46.4	34.0	97.3	49.9	37.4
TOTAL (a+b) ..	66·6	91·4	34·8	65·0	55·3	97·3	84·4	58·8
3. Working Capital	33·4	8·6	65·2	35·0	44·7	2·7	15·6	41·2
4. Total	100	100	100	100	100	100	100	100

7.1 A comparison of figures of investment per person engaged however indicates the more advantageous position of control units particularly in the processing group. This is largely due to the very low employment afforded by industries located in control centre.

TABLE NO. 9.7

Number of Industrial Units distributed by size of total capital

Industry Group	Project				Control			
	A.	B.	C.	Total	A.	B.	C.	Total
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1. Processing ..	1	9	7	17	2	2	1	5
	(5·9)	(52·9)	(41·2)	(100)	(40·0)	(40·0)	(20·0)	(100)
2. Engineering and Repairs ..	15	3	1	19	3	—	—	3
	(78·9)	(15·8)	(5·3)	(100)	(100.0)	(—)	(—)	(100)
3. Others ..	48	4	1	53	9	—	—	9
	(90·6)	(7·5)	(1·9)	(100)	(100·0)	(—)	(—)	(100)
TOTAL	64	16	9	89	14	2	1	17
	(71·9)	(18·0)	(10·1)	(100)	(82·3)	(11·8)	(5·9)	(100)

Note : Figures in brackets represent percentages to related totals.
Explanation : A. upto Rs. 5,000
B. Rs. 5,000 to Rs. 20,000
C. over Rs. 20,000

7.2 Considering the size distribution of the sample units, it is seen that there are relatively more of units in size groups B and C, that is, having capital of more than Rs. 5,000 in the project area (Table No. 9.7). For instance they constitute 28 per cent of the sample units in the project area as against 17.7 per cent in Hanumangarh. There are no larger units in the second and third groups in the control centre.

Employment

8.0. Capital, however, is not the only index of size of a unit. The distribution by employment given in Table No. 9.8 suggests that there are more units with more than 10 persons engaged in project area or 12.4 per cent in project area as against 5.9 per cent in Hanumangarh. Persons engaged include both owner operator and members of his family as also hired labourers. Although there are differences between groups, it is a noteworthy feature that there is not a single establishment employing more than 20 persons in the control centre, although in the project area such units approximate 7 per cent of the total. By and large, most of the units studied both in the project and control areas are fairly small enterprises employing less than 10 persons.

8.1. The average empolyment also is higher in project area in all the three groups of industries. The highest average employment is in the processing group, particularly, under cotton gins and among other services.

TABLE No. 9.8

Number of units distributed by employment categories

Industry Group	Project				Control			
	a.	b.	c.	Total	a.	b.	c.	Total
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1. Processing :								
(i) Flour	8	1	—	9	3	1	—	4
(ii) Cotton	1	—	2	3	—	—	—	—
(iii) Others	4	1	—	5	1			1
Sub Total	13 (76·4)	2 (11·8)	2 (11·8)	17 (100·0)	4 (80·0)	1 (20·0)	—	5 (100·0)
2. Engineering and Repairs	18 (94·7)	1 (5·3)	— —	19 (100·0)	3 (100·0)	— —	— —	3 (100·0)
3. Others								
(i) Confectioners	22	1	—	23	4	—	—	4
(ii) Leather and Footwear ..	9	—	—	9	2	—	—	2
(iii) Brick Kilns	—	1	4	5	—	—	—	—
(iv) Personal services	9	—	—	9	1	—	—	1
(v) Miscellaneous	7	—	—	7	2	—	—	2
Sub Total	47 (88·7)	2 (3·8)	4 (7·5)	53 (100·0)	9 (100·0)	—	—	9 100·0
Grand Total	78 (87·6)	5 (5·6)	6 (6·8)	89 (100·0)	16 (94·1)	1 (5·9)	— —	17 (100·0)

Note:— 1. (a) Units having up to 10 persons : (b) Over 10 and up to 20 persons (c) Over 20 persons.
2. Figures in brackets represent percentage to related totals.

under brick kilns (Table No. 9.9). It would be noted, that both these types of industries are not found in the control centre. While there are certain other differences in various groups, it would appear that the employment per unit in the project area on the whole is nearly twice as large as in the control area. The above conclusions are not affected even if we compared employment to population. There are more persons employed per 1000 of population in all the groups, The employment is most markedly higher among the various consumer goods manufacturers and services and to a lesser extent, among engineering establishments. In the former group, the increased employment is not an attribute of increase in number of such establishments. Indeed, the position is fairly comparable in both the areas. It is largely accounted by the higher average employment here as also the significant proportion of hired labour in this group.

TABLE No. 9.9

Number of Persons engaged (per unit and per 1000 of population)

Industry Group	Project				Control			
	No. of Units	Persons engaged	No. per Unit	No. per 1000 population	No. of Units	Persons engaged	No. per Unit	No. per 1000 population
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1. **Processing:**								
(*i*) Flour ..	9	51	5·7	3·00	4	25	6·3	8·03
(*ii*) Cotton ginning ..	3	71	23·7	4·18	—	—	—	—
(*iii*) Others ..	5	40	8·0	2·35	1	2	2·0	0·67
(*iv*) Total (i-ii-iii)	17	162	9·5	9·53	5	27	5·4	8·70
2. Engineering & Repair Services ..	19	60	3·2	11·42	3	6	2·0	7·63
3. Other services:								
(*i*) Restaurants & Confectioners ..	23	66	2·9	25·13	4	7	1·8	15·28
(*ii*) Leather & footwear	9	25	2·8	9·52	2	5	2·5	10·92
(*iii*) Brick Kilns	5	184	36·8	70·07	—	—	—	—
(*iv*) Personal services ..	9	17	1·9	6·47	1	1	1·0	2.18
(*v*) Miscellaneous	7	19	2·7	7·24	2	5	2·5	10·92
(*vi*) Total (i-v) ..	53	311	5·9	118·43	9	18	2·0	39·29
GRAND TOTAL	89	533	6·0	149·17	17	51	3·0	73·35

8.2. A breakdown of employment by paid and unpaid categories further suggests the predominence of hired labour in the project area (Table No. 9.10). This is true of all groups of industries, although it is in the last group that the hired labour is most significant. On the other hand, in the control centre there are mainly own-account concerns in this group with no hired labour of any sort. In the other groups, hired labour has been reported although even here, proportionately it is larger in the project area.

TABLE No. 9.10

Employment by paid and unpaid categories

(Percentage distribution)

Industry Group	Project			Control		
	No. of units	Paid	Un-paid	No. of units	Paid	Un-paid
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1. Processing :						
(*i*) Flour	9	68·6	31·4	4	76·0	24·0
(*ii*) Cotton-ginning	3	94·4	5·6	—	—	—
(*iii*) Others	5	83.3	17.5	1	50.0	50.0
(*iv*) Total (*i-iii*) ..	17	83·3	16·7	5	74·1	25·9
2. Engineering & Repair services						
3. Other services : ..	19	55·0	45·0	3	33·3	66·7
(*i*) Restaurants & Confectioners	23	34·8	65·2	4	—	100·0
(*ii*) Leather & Foot-wear	9	4·0	96·0	2	—	100·0
(*iii*) Brick Kilns ..	5	91·9	8·1	—	—	—
(*iv*) Personal services	9	23·5	76·5	1	—	100·0
(*v*) Miscellaneous	7	26·3	73·7	2	—	100·0
(*iv*) Total (i-v) ..	53	65·0	35·0	9	—	100·0
GRAND TOTAL ..	89	69·4	30·6	17	43·1	56·9

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8.3 Further analysis by quality that is skilled and unskilled labour shows that there is greater employment of skilled labour in the project area or on an average 62 per cent as against 27 per cent in the control centre. (Table No. 9.11). This, however, applies mainly to flour mills, engineering enterprises and other consumer services. In the processing group generally the skilled labour is higher in the control units. This could be attributed to the factor of predominence of own-account workers who largely provide managerial and other skilled services.

TABLE No. 9.11

Percentage distribution of supervisory, skilled and un-skilled labour

Industry Group	Project			Control		
	Supervisory	Skilled	Unskilled	Supervisory	Skilled	Unskilled
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1. Processing	10	26	64	20	30	50
2. Engineering ..	3	64	33	—	—	100
3. Others	4	86	10	—	—	—
Average ..	6	62	32	18	27	55

9.0. An analysis of production costs in secondary activities is relevant to benefit estimation in so far as it sheds light on the extent and direction of additional incomes created in these activities. Thus for instance, the difference made by irrigation to mention mainly the processing group of industries, could be seen in the higher payments to labour, taxes, and returns to capital and enterprenurial elements. Such an analysis, however, is possible only when complete data regarding all items of expenses, and output are available. This could not be gathered for obvious reasons from units which were more recently set up. It was, therefore, considered necessary to restrict the study of cost aspects to such of the industries as were fully established and which were in operation for more than a year. This had naturally reduced the sample units somewhat particularly in the control centre.

9.1. Table No. 9.12 gives figures of average production expenses under different items. Percentage distribution of cost is indicated in Table No. 9.13. Before considering these figures mention may be made of certain limitations in the data. Firsty, while most of the units have rented premises. some 16 units (18 per cent of the total), located mainly in the groups (i) and (iii) have reported owned buildings. Although rent conceptually arises in the case of these units as well, it has not been imputed considering that such a difference would be reflected in the larger profit or net output of these undertakings. Besides imputation of urban rents presented many difficult problems. In regard to interest, however, only 4 units (5 per cent of the total), mainly located in the colony area have reported any interest payments. Most of the concerns had repaid their capital obligations and outstanding debt, if any, was negligible. In their case interest at 4 per cent was charged on value of total capital. Some of the units could not report tax payments as assessments were still pending. The figures of tax returns given here could thus be considered as an understatement. These differences are not of magnitude as to materially affect our generalisations although admittedly, difference would be significant if we were to appraise individual undertakings.

TABLE NO. 9.12

Production expenses under selected items

(In Rs. 000's)

Industry	No. of Units		Raw Material		Wages		Taxes		Others		Total expenses	
	Project	Control	Project	Control	Project	Control	Project	Control	Project	Control	Project	Control
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
1. *Processing*												
(*i*) Flour ..	8	2	3,343·8 (417·9)	331·8 (165·9)	23·3 (2·9)	11·5 (5·8)	0·1 (—)	0·5 (—)	29·4 (6·2)	22·0 (11·0)	3,416·7 (427·0)	365·3 (182·7)
(*ii*) Cotton ..	3	—	1,848·1 (609·8)	— —	31·3 (10·3)	— —	1·8 (0·6)	— —	75·8 (25·2)	— —	1,957·0 (645·8)	— —
(*iii*) Others ..	5	—	116·7 (23·3)	— —	20·0 (4·0)	— —	0·4 (—)	— —	29·4 (5·9)	— —	166·6 (33·3)	— —
Sub TOTAL	16	2	5,308·6 (331·8)	331·8 (165·9)	74·6 (4·6)	11·5 (5·8)	2·4 (0·1)	0·5 (—)	154·6 (9·7)	22·0 (11·0)	5,540·3 (346·3)	365·3 (182·7)
2. Repair Services and Engg.	17	2	11·4 (0·7)	0·7 (0·3)	22·6 (1·3)	0·2 (—)	0·1 (—)	— —	21·7 (1·3)	3·5 (1·7)	55·8 (3·3)	4·3 (2·2)
3. *Other services*												
(*i*) Restaurant & confectioners	20	1	56·5 (2·8)	5·8 (5·8)	13·0 (0·6)	— —	0·03 (—)	0·01 (—)	12·9 (0·6)	0·4 (0·4)	82·9 (4·1)	6·2 (6·2)
(*ii*) Footwear ..	8	2	16·1 (2·0)	2·8 (1·4)	0·6 (0·07)	— —	— —	— —	1·0 (0·1)	0·8 (0·4)	17·8 (2·2)	3·6 (1·8)
(*iii*) Bricks Kilns	4	—	—	—	72·5 (18·1)	— —	10·0 (2.5)	— —	93·4 (23·4)	—	166·7 (41·5)	—
(*iv*) Personal services ..	8	1	2·4 (0·3)	60 (60)	1·9 (0·2)	—	0·01 (—)	—	3·0 (0·4)	—	7·4 (0·9)	—
(*v*) Miscellaneous ..	6	2	9·8 (1·6)	2·3 (1·2)	3·7 (0·6)	—	—	—	15·9 (2·6)	1·3 (0·6)	18·2 (3·0)	3·7 (1·8)
Sub TOTAL	46	6	84·8 (18·4)	10·9 (1·8)	91·9 (2·0)	—	10·4 (0·2)	— —	105·1 (2·3)	2·5 (0·4)	292·3 (6·4)	13·5 (2·2)
GRAND TOTAL	79	10	5,404·8 (68·4)	343·4 (34·3)	189·3 (2·4)	11·7 (1·2)	12·9 (0·2)	0·06 (—)	281·4 (3·5)	28·0 (2·8)	5,888·4 (74·5)	383·1 (38·3)

NOTE.—Figures in brackets represent average value per unit.

9.2. It would be observed from figures in Table No. 9.12 that on an average the production expenses are nearly twice as high in project industries as for the units in the control centre. The more conspicuous increase is observed in respect of units in groups (i) and (iii). The principal item of cost in the processing group is evidently, raw material. Per unit the expenditure on raw materials is over two and half times as large in the project area as in the control area. This may be taken as an index of the higher demand and greater utilisation of capacity for processing of farm products. Percentage expenditure under this item again is higher among the project units (Table No. 9.1). Indeed, considering flour milling, which is the main processing activity in both the areas, almost the entire expenditure is made up of outlay on raw materials. The excessive proportion of raw material to total cost seems to suggest that the units under study do processing on their own account. Secondly only 2 out of the 8 selected units in the project area and one in the control area undertook such processing, although these were fairly large establishments and as such had influenced the averages. The expenditure on raw materials relative to total cost is also higher in the consumer services group especially in the control area. Considering engineering establishments, factor costs are conspicuous by their wide disparities. While the total costs per unit is higher in the project area, the distribution, however, varies markedly between the two areas as also within the group between units using power and those which are not using power. In general, it has been observed that those establishments using power had larger expenditures particularly on items as wages and raw materials. The wage component is more significant among project units while fuel costs and repairs constitute greater percentage of cost among control units. In the third group as well, besides raw materials, wage payments are proportionately larger in the project area. The latter expenditure has not been reported in the control centre as there is no hired labour. The larger size of operation in the project area indicated by these figures provide a measure of benefits of irrigation. While there is general increase of expenditure under all items, larger taxes paid out by project units are indicative of the benefits accruing to public authority.

9.3. The foregoing conclusions are broadly sustained even if we compare cost in relation to value of output (Table No. 9.14). For instance raw materials constitute the highest proportion of output value in the processing group where as wage payments are more significant in the other groups. It would also be observed that the percentage of net income or net output is sizeable especially in the second group. It is lowest in the processing group with about 1/10th of gross output. The figures of net income or net output are residuary values and include returns to owner-operator for his own labour besides other returns to property, risk and management. It is also noteworthy that a greater share of the output value is appropriated by expenditure on repairs and maintenance as also under

TABLE No. 9.13

Expenditure under various items as per cent of total (*Project Area*)

Industry	Rent	Raw materials	Wages	Fuels & Power	Repairs	Depre-ciation	Interest	Taxes	Transport & Others	Total
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Processing :										
(*i*) Flour	0·04	97·87	0·68	0·61	0·22	0·26	0·28	—	0·04	100
(*ii*) Cotton	—	94·44	1·60	1·38	0·92	0·41	0·39	0·09	0·77	100
(*iii*) Others	1·06	70·05	12·05	5·70	2·27	2·99	2·07	0·26	3·60	100
SUB TOTAL	0·06	95·82	1·35	1·04	0·53	0·30	0·37	0·04	0·40	100
Engineering & Repairs	12·03	20·38	40·49	10·91	4·25	7·70	2·78	0·21	1·25	100
Others :										
(*i*) Confectioners	5·05	68·17	15·79	7·03	0·39	2·44	0·27	0·43	0·43	100
(*ii*) Leather & footwear	3·99	90·86	3·38	—	1·09	0·33	0·35	—	—	100
(*iii*) Brick Kilns	1·00	—	43·71	46·69	0·20	1·51	0·84	6·05	—	100
(*iv*) Personal services	23·38	32·82	26·38	6·85	4·91	3·96	1·03	0·17	—	100
(*v*) Miscellaneous	6·19	53·66	20·48	2·58	2·25	11·33	3·45	—	0·06	100
SUB TOTAL	3·23	29·03	31·45	28·85	0·55	2·38	0·82	3·56	0·13	100
GRAND TOTAL	0·38	91·79	3·21	2·51	0·56	0·55	0·42	0·23	0·40	100

TABLE NO. 9.13—*contd.*

Expenditure under various items as per cent of total (*Control Area*)

Industry	Rent	Raw Matarials	Wages	Fuels & Power	Repairs	Deprecia-tion	Interest	Taxes	Transport & Others	Total
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Processing	0·07	90·81	3·15	2·81	0·90	1·06	0·89	0·01	0·30	100
Engineering & Repairs	12·47	16·17	4·04	23·09	23·09	16·91	4·23	—	—	100
Others										
(*i*) Confectioners	2·33	93·19	—	3·88	0·08	0·19	0·14	0·19	—	100
(*ii*) Leather & Footwear ..	0·67	78·64	—	1·40	0·42	11·21	0·67	—	6·99	100
(*iii*) Personal serivces ..	—	89·50	—	—	7·46	1·52	1·52	—	—	100
(*iv*) Miscellaneous ..	8·48	63·72	—	2·76	0·14	20·10	4·91	—	—	100
SUB TOTAL	3·48	81·37	—	2·90	0·22	8·51	1·57	0·09	1·86	100
GRAND TOTAL ..	0·32	89·64	3·05	3·04	1·13	1·50	0·95	0·02	0·35	100

depreciation in the control area which is suggestive of the greater wear and tear of the plant and equipment here. In other respects, however, the pattern is similar.

TABLE No. 9.14

Expenditure on various items as per cent of gross production

Particulars	Processing		Repairs		Others		Total	
	Project	Control	Project	Control	Project	Control	Project	Control
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1. Rent ..	0·05	0·07	5·78	6·51	2·05	1·75	0·29	0·32
2. Raw materials	85·88	94·50	9·80	8·43	18·44	40·87	79·98	88·92
3. Wages ..	1·21	3·28	19·46	2·11	19·99	—	2·80	3·02
4. Repairs and Depreciation	0·82	2·04	5·74	20·87	1·86	4·38	0·98	2·61
5. Taxes ..	0·04	0·01	0·10	—	2·26	0·04	0·19	0·02
6. Fuels ..	0·93	2·91	5·25	12·05	18·33	1·46	2·19	3·01
7. Interest ..	0·34	0·93	1·33	2·20	0·52	0·79	0·36	0·95
8. Transport and others ..	0·36	0·31	0·60	—	0·08	0·93	0·35	0·35
TOTAL Cost as per cent of output	89·63	104·05	48·06	52·17	63·53	50·23	87·14	99·20

Gross product

10.0. A comparison of figures of average output (gross) given in Table No. 9.15 also corroborates the earlier indication of the more favourable position of project industries. Thus gross production per unit is 120 per cent and 122 per cent higher respectively in the project area among processing and consumer services. In group (ii) also, the increase is significant. This picture is not changed when comparison is made with population although the relative significance of groups is changed. For all the sample units taken together, it is seen that production per 1,000 persons is higher by 118 per cent in the project area.

TABLE NO. 9.15

Value of Gross output (Rs. per unit and per 1,000 of population)

(In. Rs. 000's)

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Industry Group	PROJECT			CONTROL		
	No. of units	Output	Output per 1,000 population	No. of units	Output	Output per 1,000 population
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1. *Processing* :						
(*i*) Flour ..	8	4184·9 (523·1)	261·2	2	351·1 (175·5)	282·5
(*ii*) Cotton ..	3	1803·1 (601·0)	112·6	—	—	—
(*iii*) Others	5	193·1 (38·6)	12·1	—	—	—
SUB TOTAL ..	16	6181·1 (386·3)	385·9 24·8	2	351·1 (175·5)	—
2. General Engineering and Repair services ..	17	116·2 (6·8)	2	2	8·30 (4·2)	— 282·5 15·8

TABLE No. 9.15—*contd.*

(1)	(2)	(3)	(4)	(5)	(6)	(7)
3. Other manufacture & Services:						
(*i*) Restaurants & Confectionaries	20	170·3 (8·5)	74·8	1	11·3 (11·3)	37·2
(*ii*) Footwear ..	8	32·5 (4·1)	14·3	2	10·1 (5·1)	33·2
(*iii*) Brick kilns ..	4	219·9 (55·0)	96·6	—	—	—
(*iv*) Personal services ..	8	16·2 (2·0)	7·1	1	1·0 (1·0)	3·3
(*v*) Miscellaneous	6	21·2 (3·5)	9·3	2	4·4 (2·2)	14·5
SUB TOTAL ..	46	460·1 (10·0)	202·1	6	26·8 (4·5)	88·2
GRAND TOTAL ..	79	6,757·4 (85·5)	2,124·3	10	386·2 (38·6)	972·8

NOTE:—Figures in brackets indicate average output.

Value added by manufacture

11.0. Table No. 9.16 gives figures of value added in various groups.(5) A principal conclusion indicated by these figures is that, on an average, net value added by manufacture for undertakings project area is over 6 times larger. The maximum increase is observed in the processing group. Significant as the magnitude of difference is, it also indicates the preponderance of larger units in the project area. Value figures in other groups vary to a greater or lesser extent in comparison to control area although consistently they are higher in the project. A further comparison of figures of value added per worker confirm above conclusions. Overall, the value added per worker in the project industries is nearly 5 times as large as in the control industries. The difference is particularly marked in the processing group. This has been influenced by two large processing units which between themselves account for 99 per cent of output value. The employment again is small in these units.

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(5) Value added here means the difference between gross output and cost of raw materials, fuels, other materials consumed in the process of manufacture depreciation of plant and equipment.

TABLE NO. 9.16

Value added by manufacture (per unit and worker)

Industry Group	Project				Control			
	No. of units	Persons engaged	Total Value	Value per worker	No. of units	Persons engaged	Total Value	Value per worker
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1. ***Processing*** :								
(*i*) Flour	8	44	8,04,253 (1,00,532)	18,279	2	18	1,934 (967)	107
(*ii*) Cotton ginning ..	3	71	—98,134 (32,711)	—1,182	—	—	—	—
(*iii*) Others	5	40	58,271 (11,654)	1,457	—	—	—	—
TOTAL	16	155	7,64,390 (47,774)	4,932	2	18	1,934 (967)	107
2. Engineering and Repairs ..	17	52	92,041 (5,414)	1,770	2	4	4,868 (2,434)	1,217
3. Others Manufacture and Services:—								
(*i*) Restaurants & Confectioners	20	57	1,05,540 (52,770)	1,852	1	3	5,273 (5,273)	1,758
(*ii*) Footwear	8	23	16,122 (2,015)	701	2	5	6,821 (3,410)	1,364
(*iii*) Brick kilns	4	129	1,39,588 (34,897)	1,082	—	—	—	—
(*iv*) Personal services ..	8	14	12,603 (1,575)	900	1	1	934 (934)	934
(*v*) Miscellaneous ..	6	16	8,524 (1,421)	533	2	5	1,253 (626)	251
SUB TOTAL ..	46	239	2,82,377 (6,139)	1,182	6	14	14,281 (2,380)	1,020
GRAND TOTAL ..	79	446	11,38,808 (14,414)	2,553	10	36	21,083 (2,108)	586

NOTE.—Figures of value are rounded off to the nearest Rupee.

Figures in brackets indicate average value added per manufacturing unit.

11.1. A breakdown of the figures of net value added suggests further that it is net earnings or what might be broadly termed as profits that account for the most significant proportion of the value added (Table No. 9.17). This is particularly so among the processing industries in the project area. The net earnings represent mainly returns to the owner-operator for his own labour and that of his family as also returns on own capital. This is followed by wage payments and taxes which proportionately are more significant in the project area especially under consumers goods industries and services. On the other hand, the miscellaneous other items as transport etc. account for a larger share of the value added in the control area in both the second and third groups. It has not been possible to reproduce data for processing units in the control area as these have reported a net loss during the year of enquiry, rendering difficult an adequate comparison with project units.

TABLE NO. 9.17

Breakdown of net value added by participating factors

Particulars	Processing		Engineering		Others	
	Project	Control	Project	Control	Project	Control
(1)	(2)	(3)	(4)	(5)	(6)	(7)
(*i*) Wages and Salaries ..	74,728 (9·78)		22,610 (24·57)	175 (3·59)	91,941 (32·56)	— —
(*ii*) Taxes ..	2,398 (0·31		115 (0·12)	— —	10,400 (3·68)	12 (0·08)
(*iii*) Net output ..	6,40,754 (83·83)		60,346 (65·56)	3,970 (81·56)	1,67,818 (59·43)	13,340 (93·41)
(*iv*) Others (interest, rent and transport) ..	46,510 (6·08)		8,970 (9·75)	723 (14·85)	12,218 (4·33)	929 (6·51)
TOTAL ..	7,64,390 (100)		92,041 (100)	4,868 (100)	2,82,377 (100)	14,281 (100)

N.B.—Figures of value rounded off to the nearest Rupee.

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Net benefits

12.0. The foregoing estimates relate to gross benefits arising in secondary activities. Making allowance for the costs as well, benefits could be expressed as net incomes or profits arising in processing activities and which may be attributed to the farm products under processing. Considering only the processing group which is relevant for this purpose and making use of measurement practices as adopted by the Bureau of Reclamation (USA), it would be observed from Table No. 9.18 that the benefit factor varies between a negative value of 7.9 per cent in the case of cotton to 22.5 per cent in the case of wheat.(6)

TABLE No. 9.18

Secondary benefit factors in selected processing units

Particulars	Project			Control	
	Flour	Cotton Ginning	Other processing units	Total processing	Flour
(1)	(2)	(3)	(4)	(5)	(6)
1. Gross product ..	4,185	1,803 (507)	913	6,181	351
2. Total cost ..	3,417	1,957 (426)	166	5,540	365
3. Net output ..	768	(—)154	27	641	(—) 14
4. Cost of raw material ..	3,344	1,848	117	5,309	332
5. Share of net output to raw material (3 × 4/2) ..	752	(—)145 (72)	19	614	(—)13
6. Percentage net benefit to value of raw material $\frac{5 \times 100)}{4}$	22·5	(—) 7·9 (19·1)	16·0	11·6	3·9

NOTE.—Figures in brackets indicate returns in respect of undertakings which have reported net profits.

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(6) The Bureau recognises "indirect" benefits in processing activities as those contributions to increased production at existing manufacturing plant or at new industrial developments. The net indirect benefits are calculated by subtracting the incremental costs associated with the increase in the value of the approriate end-products. Usually, however, the indirect benefits are estimated through the use of "factors' which represent the proportionate share of the benefits to the project from extended economic activities which depend in whole or in part on the production of goods from the project. The following steps illustrate calculation :

(*i*) determine the value of the end-product, *e.g.* in the case of processing this would be the total value of the finished product;

(*ii*) determine the costs involved;

(*iii*) determine the total benefit *i.e.* (*i*) minus (*ii*) above;

(*iv*) determine the share of the benefits found in item (*iii*) above. Since the total benefit of economic activity are considered to be a function of all costs this share will be the ratio of the cost to the project commodity supplied to the total cost of the economic activity.Thus in effect, this procedure prorates the benefits among the cost items in proportion to their monetary value.

(*v*) determine the "indirect" benefit factor. This is the percentage ratio of the benefit credited to the commodity (determined as above item). To illustrate if 25 million dollars worth of a given commodity was credited with 5 million dollars of benefits, the indirect benefit factor would be 5 million—25 million × 100 or 20 per cent. This factor is applied to the net direct benefit from the project commodity. In practice, however, it is seldom possible to determine separately the farm costs for a single product. Therefore, nearly in all cases, the indirect benefit factor is applied to the "gross" farm value from the project commodity and appropriately adjusted to obtain the indirect benefit associated with the federal project cost (Bureau of Reclamation—Manual Vol. XIII).

12.1. These have been estimated from cost-output data relating to project undertakings. On the other hand, in respect of flour making the estimated benefit factor for the control area is about 4 per cent. The difference between the project and the control area would thus indicate the additional net benefits accruing to secondary activities processing wheat as a result of canal irrigation. Even in the case of cotton, it was observed that the negative value was largely influenced by heavy investment in raw materials by one undertaking which consequently showed loss. Excluding this unit, however, the benefit factor works out to a positive value *i.e.* 19 per cent. The miscellaneous other undertaking (largely saw mills and oil crushers) show a factor of 16 per cent. In the absence of comparable units in control area, however, it is not possible to indicate the net additional benefits here. As earlier observed, the sample units undertook other functions and the benefit factors as derived here might in part be attributed to other farm products being processed *e.g.* cotton, oilseeds etc. As such these benefit factors are composite and serve to indicate roughly the difference in the order of benefits which may be credited to the factor of irrigation.

CASE STUDIES

13.0. Besides the sample units indicated above, cost and output data for a few large processing units were gathered in a supplementary study of secondary benefits. From the point of view of size of their operations and consequently, the benefits arising from such operations, a study of these units in some detail was useful. This study concerns one sugar factory and three textile units all located in the project area. The data for the sugar factory were taken from the annual reports and balance-sheets for the years 1956-57 and 1957-58. The data could not be collected for the year of reference as accounts were not as yet closed. Similar source materials were not available for the textile units. As such data on the basis of proforma specifically designed for larger establishments were gathered for these units and relate to the reference year 1958-59. While cross comparison of these units are thus difficult, the figures serve to illustrate broadly the magnitude of benefits that may be associated with large processing activities of the type described here.

Sugar

14.0. The manufacture of sugar here has assumed considerable significance in recent years. The sugar factory located at Ganganagar and controlled by the State Government processes sizable part of the cane produced in the colony. This major secondary activity could not have arisen without irrigation. The factory was set-up in 1945 and crushing operations commenced in the following year. The factory with a fixed capital of Rs. 25 lakhs produces besides sugar, molasses and liquor. The factory had the following establishment in the year 1957-58 (Table No. 9.10).

TABLE No. 9.19

Category	Number of persons employed	
	No.	Per cent
Supervisory	86	8·14
Skilled	323	30·49
Unskilled	647	61·27
TOTAL	1,056	100·00

The industry being seasonal, employment of labour necessarily fluctuates and tapers off towards the close of the working season. The wage rates for the unskilled labour vary from Rs. 1.6 to Rs. 2. The percentage of daily rated labour, however, is small bulk of labour force being mainly salaried. The monthly rate may vary between Rs. 50 to Rs. 80. Wages account for about 6 per cent of the total cost. The factory draws labour from the States of U.P. and Bihar.

14.1. Table No. 9.20 gives data regarding cost and output by the principal components. In Table No. 9.21 is given the value added and its breakdown. It would be seen that both production and profits have recorded a high level in the year 1957-58 as compared to the previous year. Considering the average figures for the two years, profits amounted to Rs. 7.34 lakhs or 6.2 per cent of output. Expenditure on raw materials obviously constitutes the most important element of cost. Outlay on raw materials includes some on spirits and other materials. Next to raw materials taxes account for about 10 per cent of cost or 15 per cent of value added. In the main, this represents excise duty and provides a measure of the indirect benefits accruing to the Government. Against this benefit, allowance will have to be made for cost of collection and other expenses attendant on administration of the tax. It is, however, unlikely that such expenses are materially significant. Nearly half the total excise collections from the colony is contributed by the sugar factory and is a credit item of the Gang Canal. The cost of production of sugar in general has been Rs. 27 per maund, including the excise duty of Rs. 10.70. About 28 per cent of the value is, thus, accounted by tax payments. Besides, taxes, the other items are not likely to have had any appreciable impact on local employment and trade. The expenditure under transport for instance represents receipts of the railway authorities both for bringing in the cane from the main producing areas in the neighbourhood as also carrying the finished products to the various distribution centres.

TABLE No. 9.20

Production expenses and output particulars

(Rs. crores)

S. No.	Particulars	1956-57	1957-58	Average
(1)	(2)	(3)	(4)	(5)
	Cost:			
(*i*)	Raw Materials	44·01	37·81	40·91
		(50·2)	(28·4)	(37·1)
(*ii*)	Wages and Salaries	5·90	6·86	6·38
		(6·7)	(5·1)	(5·8)
(*iii*)	Fuel and Light	1·16	1·92	1·54
		(1·3)	(1·4)	(1·4)
(*iv*)	Repairs and Maintenance	0·30	0·63	0·46
		(0·30)	(0.5)	(0·4)
(*v*)	Taxes	4·59	16·70	10·64
		(6·8)	(12·6)	(9·6)
(*vi*)	Transport	0·56	0·75	0·66
		(0·6)	(0·6)	(1·3)
(*vii*)	Interest	1·14	1·77	0·66
		(1·3)	(1·3)	(1·3)
(*viii*)	Depreciation	1·65	2·06	1·85
		(1·9)	(1·6)	(1·7)
(*ix*)	Insurance	0·32	0·36	0·33
		(0·4)	(0·3)	(0·3)
(*x*)	Others	28·14	64·12	46·15
		(32·1)	(48·2)	(41·8)
	TOTAL (*i—x*)	87·77 (100·0)	132·98 (100·00)	110·37 (100·0)
	Output:			
(*i*)	Sugar : (*a*) Sold	26·11	60·63	43·37
		(27·8)	(42·8)	(36·8)
	(*b*) Unsold	22·21	18·47	20·34
		(23·7)	(13·0)	(17·3)
(*ii*)	Bye-Products :			
	(*a*) Sold	9·94	18·11	14·03
		(10·0)	(12·8)	(11·9)
	(*b*) Unsold	9·96	11·99	10·84
		(10·3)	(8·5)	(9·2)
(*iii*)	Miscellaneous other receipts	25·87	32·40	29·13
		(27·6)	(22·9)	(24·8)
	TOTAL (*i—iii*)	93·82	141·60	117·71
		(100·0)	(100·0)	(100·0)

Figures in brackets represent percentage to respective totals.

TABLE No. 9.21

Net value added by principal items

(Rs. Lakhs)

Particulars	1956-57	1957-58	Average
(1)	(2)	(3)	(4)
Wages and Salaries	5·90	6·86	6·38
	(12·63)	(6·92)	(8·75)
Taxes	4·59	16·70	10·64
	(9·83)	(16·84)	(14·58)
Interest	1·14	11·77	1·45
	(2·45)	(1·78)	(1·99)
Profit	6·05	8·62	7·34
	(12·95)	(8·69)	(10·06)
Others	29·02	65·23	47·14
	(62·14)	(65·77)	(64·62)
TOTAL ..	46·70	99·18	72·95
	(100)	(100)	(100)

NOTE.—Figures in brackets represent proportion to total Net Value added.

14.2. From figures in Table No. 9.21 it is seen that the net value added amounts to Rs. 73 lakhs on an average which is about 62 per cent of gross production. The main conclusion suggested by the Table is that for every rupee of value received by the Project farmers for cane sold for processing Rs. 0.61 is received by the rest of the economy distributed as follows : Rs. 0.16 to labour, Rs. 0.26 to Government and Rs. 0.19 to other factors as management, capital etc. Expressing it differently, that is, in terms of net benefits and using the concept of benefit factor it will be observed from Table No. 9.25 that the benefit index varies between 6.5 per cent to 6.9 per cent for the years 1956–58 or on an average 6.7 per cent. This factor applied to cost of raw materials (that is Rs. 20.2 lakhs), gives a net secondary benefit of the order of Rs. 1.35 lakhs.

Textile Industry

15.0. With the rapid extension of cotton cultivation in the colony, cotton ginning and carding activities have assumed importance in the area. A good number of the textile units in the State are located in the Ganganagar District, this again mainly in the project area. We attempted to gather some data regarding this growing industry. It will be observed from Table No. 9.22 that the three large units selected for the study have between themselves a total capital of over Rs. 11.7 lakhs. The units are dissimilar in size of capital and labour employed. For instance, employment in these units vary between 26 to as many as 302 persons or on an average 124 persons per undertaking. The qualitative classification of labour further suggests that while unskilled labour obviously predominates in the industry, the composition of labour force, however, is not comparable between the three units. It is interesting that the unit which has reported the highest capital also has recorded the maximum employment.

TABLE NO. 9.22

Investment and employment particulars of selected industrial establishments

(In Rupees Thousands)

Particulars	Unit (1)		Unit (2)		Unit (3)		Average	
	Rs.	Per cent	Rs.	Per cent	Rs.	Per cent	Rs.	Per cent
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Investment								
Fixed Capital ..	91·0	78·4	200·0	50·0	460·0	69·7	250·3	63·9
Working Capital	25·0	21·6	200·0	50·0	200·0	30·3	141·7	36·1
TOTAL ..	116·0	100·0	400·0	100·0	660·0	100·0	392·0	100·0
	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent
Persons employed								
Supervisory ..	2	4·4	6	23·1	15	5·0	7·6	6·2
Skilled	13	28·9	5	19·2	30	9·9	16·0	12·9
Unskilled ..	30	66·7	15	57·7	257	85·1	100·7	80·9
TOTAL ..	45	100·0	26	100·0	302	100·0	124·3	100·0

15.1. Table No. 9.23 shows cost and output data as also percentage distribution under different items of cost. The data are not complete in all respects. For instance, only one unit has paid rent. Others have their own premises but no imputed value under this item has been included in their case. Data regarding depreciation could also not be gathered. Subject to these limitations, it will be seen that raw materials constitute on an average about 91 per cent of the total cost. Almost the entire supply of raw material for these units is provided by the colony. All other elements of cost are relatively insignificant. The value of gross production varies from about Rs. 41,000 to as much as Rs. 27.5 lakhs or on an average Rs. 11.6 lakhs.

15.2. It will further be observed from figures in Table No. 9.24 that the net value added by manufacture is high in this industry amounting to Rs. 1.23 lakhs. The breakdown of value added by the principal factors further suggests that profits and wages account for greater part of the value added by manufacture. Next, taxes account for 5 per cent of the net value added. These figures provide a measure of the benefits conferred by this important processing activity in the project area.

15.3. Expressing benefits differently that is in terms of share of net value of profits attributable to farm products under processing, it will appear from Table No. 9.25 that the benefit factor is on an average 6.7 per cent in

TABLE NO. 9.23

Production expenses and output of selected textile units

Particulars	Unit (1)		Unit (2)		Unit (3)		Average	
	Rs.	Per cent	Rs.	Per cent	Rs.	Per cent	Rs.	Per cent
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Production expenses :								
(*i*) Wages and Salaries	10,872	22·5	12,340	2·0	1,04,1000	4·0	42,437	3·9
(*ii*) Rent (Paid)	8,000	16·6	—	—	—	—	2,667	0·3
(*iii*) Fuel	13,153	27·3	14,000	2·3	N.A.	N.A.	13,576	1·2
(*iv*) Raw Materials	—	—	5,65,000	92·2	24,16,000	93·7	9,93,667	91·4
(*v*) Taxes	427	0·9	154	—	19,000	0·8	6,827	0·6
(*vi*) Repairs	6,516	13·5	12,200	2·0	27,500	1·1	15,405	1·4
(*vii*) Interest (Paid)	9,240	19·2	6,000	1·0	5,600	0·2	9,405	0·9
(*viii*) Transport & Others	—	—	2,853	0·5	5,500	0·2	2,784	0·3
(*ix*) TOTAL (*i*— *viii*)	48,208	100·00	6,12,547	100·0	25,78,600	100·0	10,86,768	100·0
TOTAL OUTPUT ..	40,930	—	6,81,525	—	27,47,500	—	11,56,652	—
NET OUTPUT ..	—7,278	—	68,978	—	1,68,900	—	69,884	—

TABLE No. 9.24

Value added by participating factors

Industry	Unit (1)		Unit (2)		Unit (3)		Average	
	Rs.	Per cent	Rs.	Per cent	Rs.	Per cent	Rs.	Per cent
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Wages	10,872	51·13	12,340	13·66	1,04,100	34·24	42,437	31·67
Interest	9,240	43·46	6,000	6·65	5,600	1·84	9,405	7·02
Taxes	427	2·01	154	0·17	19,900	6·55	6,827	5·09
Profits	—7,278	—34·23	68,978	76·36	1,68,900	55·56	69,884	52·15
Others*	8,000	37·63	2,853	3·16	5,500	1·81	5,451	4·07
TOTAL ..	21,261	100·00	90,325	100·00	3,04,000	100·00	1,34,004	100·00

*Represents mainly value added by transport and rent.

respect of both sugarcane and cotton processing activities. The maximum benefit factor of 11.3 per cent is observed in respect of the largest textile unit included in the study. These factors applied to the value of farm products, in this case sugarcane and cotton sold to processing activities give a measure of the net benefits arising from processing and which could be credited to the canal project. Since raw materials here include cost of other materials although proportionately they are significant, the foregoing benefit factors serve to indicate only roughly the magnitude of benefits.

TABLE NO. 9.25

Share of the secondary benefits attributed to specific farm products (sugarcane and cotton)

(Rs. lakhs)

Particular	Sugar (Average for 1956—58)	Textiles			
		Unit (1)	Unit (2)	Unit (3)	Average
(1)	(2)	(3)	(4)	(5)	(6)
(*i*) Net output (Output – Cost) ..	7·34	—0·07	0·69	1·69	0·76
(*ii*) Share of Net output to raw material .. .. .. $\frac{\text{Net output} \times \text{Cost of raw material}}{\text{Total cost}}$	2·73	—0·14	0·64	1·58	0·68
(*iii*) $\frac{\text{(ii)} \times 100}{\text{Cost of raw material}}$	6·67	—14·00	6·55	11·26	6·8

सत्यमेव जयते

CHAPTER X

TRADE

Introduction

1.0. In the preceding chapters, primary benefits at the farm level and those arising in the secondary activities as processing industries etc. have been examined. In this chapter, the bearing of irrigation on the growth of local business and trade are considered. This primarily involves calculation of the returns of local business establishments in the form of profits, wages and salaries to those working in these establishments, other returns to capital and property such as interest, rent etc. and taxes. The problem is not so much to indicate the relationships of the various items to each other as to institute an overall comparison of trading establishments in the project area and those located outside. Use is made in such a comparison of the ratio concept, that is, of expressing various aspects of trade as employment, sales etc. in terms of local population (per 1,000 persons) This is also supplemented on some aspects by unit study.

1.1. As a first step in the study of the effects on trade, a census of all the business establishments was carried out in the four selected centres. A total of 1,860 establishments were enumerated of which 315 or 17 per cent were assumed to represent conditions of trade in the absence of irrigation. These thus constituted the control population for the enquiry. The distribution of these establishments by five main categories is indicated in Table No. 10.0. The principal consideration in this grouping was that the differential impact of irrigated agriculture on local business should be determined. For instance, in the first two categories that is, grains and other agricultural commodities and agricultural implements and machinery which have a direct relationship with irrigation, the effects of the project under study could be most clearly seen. These categories particularly satisfy the criterion laid down by the Committee of Direction that the enquiry concerning trade should relate to trade in agricultural produce of the area and in commodities required for agricultural production. These two main types of business activity are thus pivotal to our present enquiry. As regards the other categories of trade for example, general provisions, clothing and miscellaneous other trades, the size of sales and profits have a more direct relationship with the size of the population rather than the presence or absence of irrigation. In the American parlance, the first two categories are resource-based while the rest are more properly described as population-based. This is not to suggest however that the benefits of irrigation are limited to only the first two categories of trade.

General characteristics of trade

2.0 From the figures given in Table No. 10.0, it will be seen that there are more establishments in categories 1 and 2 within the project area than outside. Even in a smaller town like Raisinghnagar or a market centre as Padampur which have populations considerably less than the control town of Hanumangarh, it is observed that trading in agricultural commodities is well pronounced. This is also an index of greater wholesale business in the project area as the wholesale trading activity of the region is concentrated mainly in food grains. In the other categories, however, Hanumangarh is in a comparable or even better position.

TABLE NO. 10.0

Number of business establishments in selected centres

Category	Project				Control
	Sriganganagar	Padampur	Raisinghnagar	Total Project	
(1)	(2)	(3)	(4)	(5)	(6)
1. Grains	126 (11·3)	28 (16·0)	49 (19·1)	203 (13·2)	28 (8·9)
2. Agricultural Implements and Machinery	12 (1·1)	3 (1·7)	1 (0·4)	16 (1·0)	2 (0·6)
3. General Provisions	330 (29·6)	68 (38·9)	90 (35·0)	488 (31·6)	122 (38·7)
4. Cloth	199 (17·9)	30 (17·1)	51 (19·8)	280 (18·1)	51 (16·2)
5. Others	446 (40·1)	46 (26·3)	66 (25·7)	558 (36·1)	112 (35·6)
TOTAL ..	1,113 (100)	175 (100)	257 (100)	1,545 (100)	315 (100)

2.1. A more meaningful comparison can be made on the basis of figures in Table No. 10.1 which give indices of business activity, that is, number of establishments per thousand of local population. On this basis, again, it would be observed that there are more establishments in the project area handling agricultural products or those dealing in materials required for agricultural production. It would also be seen that as between different centres of trade, it is mainly in the district town of Sriganganagar that the ratio of trade to population is relatively less; but in the other project centres, local populations support more business activity as compared to the control town of Hanumangarh. In the latter town, however, there are more of other categories of trade. The larger number of establishments here is explained by the rapid growth of trade in recent years mainly brought about by the location of Bhakra canal colony and Administrative Offices in this town. Indeed, the new establishments or those which have not completed one year of business at the time of our enquiry, constituted about 41 per cent in this town while such expansion was relatively less in the project area, that is, 20 per cent of the total establishments. (Table No. 10.2). Evidently, the general expansion in trade has affected all categories of business activity, although the most marked increase is observed in categories 3 and 4. The greater trading activity in Hanumangarh as indicated by these figures could also be viewed as an index of benefit of irrigation, namely benefits from the extension of Bhakra canal in this area. At the same time, this is an indication that in the chain of indirect effects flowing from an irrigation project, it is the expansion in business activities and investments here which appear first.

TABLE No. 10.1

Number of business establishments

(Per 1,000 persons)

Category	Project				Control
	Sriganganagar	Padampur	Raisinghnagar	Total Project	
(1)	(2)	(3)	(4)	(5)	(6)
1. Grains..	3·46	18·52	9·61	4·72	4·10
2. Agricultural Implements and Machinery	0·33	1·98	0·19	0·37	0·15
3. Cloth	5·46	19·18	10·00	6·48	7·46
4. General Provisions	9·06	45·64	17·45	11·34	17·84
5. Others..	12·24	30·42	12·94	12·96	16·67
TOTAL ..	30·55	115·74	50·19	35·87	46·22

TABLE No. 10.2

Number of establishments (existing and newly established)

Category	Project			Control		
	Existing	New	Total	Existing	New	Total
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1. Grains	183 (90·2)	20 (9·8)	203	17 (60·7)	11 (39·3)	28
2. Agr. implements	13 (81·2)	3 (18·8)	16	1 (50·0)	1 (50·0)	2
3. General provisions	358 (73·3)	130 (26·7)	488	68 (55·8)	54 (44·2)	122
4. Cloth ..	226 (80·7)	54 (19·3)	280	37 (72·5)	14 (27·5)	51
5. Others	454 (81·4)	104 (18·6)	558	62 (55·4)	50 (44·6)	112
TOTAL :	1,234 (79·9)	311 (20·1)	1,545	185 (58·8)	130 (41·2)	315

NOTE : Figures in brackets represent percentages to related totals in Cols. (4) and (7).

2.2. A study of data suggesting distribution of establishments by the size group or value of turn-over suggests that numerically the most important are the smaller establishments constituting 40 per cent and 45 per cent respectively in the project and control towns. (Table No. 10.3). Even so, it is evident from the higher proportion of establishments occurring in group 'C' in the project area, that larger business is supported by the project population. On the other hand, there are proportionately more of medium size establishments, that is, with annual sales ranging between Rs. 10,000 to Rs. 50,000 in Hanumangarh. Further, between different categories of trade, there are more of larger establishments, although not very significant, in category 4 in the control town. In other categories, however there is apparently larger business in the project area.

TABLE NO. 10.3

Number of business establishments by size of turnover and percentage distribution

Category	Project				Control			
	A	B	C	Total	A	B	C	Total
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1. Grains	98 (48·3)	28 (13·8)	77 (37·9)	203 (100)	11 (39·3)	9 (32·1)	8 (28·6)	28 (100)
2. Agricultural Implements and Machinery	6 (37·5)	1 (6·3)	9 (56·2)	16 (100)	1 (50·2)	1 (50·0)	— (—)	2 (100)
3. Cloth	59 (21·1)	153 (50·9)	68 (28·0)	280 (100)	12 (23·5)	35 (68·6)	4 (7·9)	51 (100)
4. General Provisions	311 (63·9)	136 (27·9)	41 (8·2)	488 (100)	66 (54·1)	44 (36·1)	12 (9·8)	12 (100)
5. Others	301 (53·9)	168 (30·1)	89 (16·1)	558 (100)	68 (60·5)	37 (33·3)	7 (6·2)	112 (100)
TOTAL ..	775 (50·2)	486 (31·4)	284 (18·4)	1,545 (100)	158 (50·0)	126 (40·2)	31 (9·8)	315 (100)

NOTES :—(*i*) Figures in brackets represent percentages to totals in cols. (5) and (9).

(*ii*) A—upto Rs. 10,000
B—Rs. 10,000—Rs. 50,000
C—Over Rs. 50,000.

Sample Study

3.0. For an intensive study of selected aspects of trade in the two areas of study, a total sample of 146 business establishments was randomly drawn, of which 27 were located in the control town. In selection of establishments, a higher sampling proportion was allowed in respect of first two categories of trade since this was the principal area of our study. For other categories, the sampling fraction was not allowed to fall below a minimum of 5 per cent Besides, in order to provide better representation, it was considered necessary to select at least a minimum of two establishments in each specified turn-over range or size group. The sample so drawn worked out to an overall proportion of 7.7 per cent of the population in the project area and 8.6 per cent in the control centre. Between different categories of trade however the sample fraction had varied for reasons indicated above. Table No. 10.4 shows the distribution of sample establishments in different categories as also proportion to total establishments. It needs be mentioned that the difference in size of sample between the two areas of study would not introduce any bias since in subsequent analysis, the various indices have been worked out on the basis of population reduced by the sampling fraction.(1)

TABLE NO. 10.4

Number of business establishments and sampling fraction

Category	Project		Control	
	No.	Percent	No.	Percent
1	2	3	4	5
1. Grains	26	12·81	6	21·43
2. Agricultural Implements and Machinery	8	50·00	2	100·00
3. General Provisions	29	5·94	7	5·74
4. Cloth	19	6·79	6	11·76
5. Others	37	6·63	6	5·36
TOTAL :	119	7·70	27	8·57

(1) In relating the various characteristics to the population, the total population of project centres (43,050) and that of Hanumangarh (6,837) were reduced for different groups by the sampling fractions of these groups. The assumption is that the population reduced by the sampling fraction support the sample establishments. From the population figures so adjusted, the ratios i.e. per thousand of the population were worked out. This would ensure statistical comparability of data especially as the sampling fractions for different groups as also between project and control areas were different.

Employment

4.0. The question as to what extent, if any, irrigation, as led to expansion of trading activity may be approached with reference to certain selected indicators as employment, volume of business or turn-over and size of investment etc. A principal measure of benefit evidently is the in-

TABLE NO. 10.5

Paid and unpaid categories of employed persons in trading establishments

Category	Project							Control						
	Number of Establishments	Unpaid		Paid		Total		Number of units	Unpaid		Paid		Control	
		Number	Per 1,000 of popu.	Number	Per 1,000 of popu.	Number	Per 1,000 of popu.		Number	Per 1,000 of popu.	Number	Per 1,000 of popu.	Number	Per 1,000 of popu.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
1. Grains	26	69 (2·7)	12·5	64 (2·4)	11·6	133 (5·1)	24·1	6	15 (2·5)	10·2	6 (1·0)	4·1	21 (3·5)	14·3
2. Agricultural Implements and Machinery	8	16 (2·0)	0·7	28 (3·5)	1·3	44 (5·5)	2·0	2	2 (1·0)	0·3	5 (2·5)	0·7	7 (3·5)	1·0
3. Gen. Provisions ..	29	53 (1·8)	20·7	11 (0·4)	4·3	64 (2·2)	25·0	7	18 (2·6)	45·9	5 (0·7)	12·8	23 (3·3)	58·7
4. Cloth	19	37 (1·9)	12·7	5 (0·3)	1·7	42 (2·2)	14·4	6	13 (2·2)	16·2	2 (0·3)	2·5	15 (2·5)	18·7
5. Others	37	73 (2·0)	25·6	20 (0·5)	7.0	93 (2·5)	32·6	6	11 (1·8)	30.0	4 (0·4)	10·9	15 2·5	40·9
TOTAL ..	119	248 (2·1)	74·8	128 (1·1)	38·6	376 (3·1)	113·4	27	59 (2·2)	100·7	22 (0·8)	37·5	81 (3·0)	138·2

NOTE :—Figures in brackets represent number of persons engaged per establishment.

crease in employment and diversion of the local population into commercial activities and other distributive services in the area affected by the project. In this regard figures in Table No. 10.5 are instructive. Thus, while overall employment, relative to local population, is higher in the control centre, this feature is markedly indicated in respect of only those general trading activities which are not directly related to irrigation. On the contrary, within the project area, those establishments which handle agricultural products and farm materials have reported the most marked increase in employment that is over 73 in percentage terms as compared to the control area.

4.1. A further look at figures of employment by paid and unpaid categories also suggests that such an increase has been mainly in the category of paid employment (Table No. 10.6). In the case of other categories of trade, more especially among cloth stores, there is larger employment in Hanumangarh whether of paid or unpaid category. In the main, there is more of unpaid or family labour in the control town. The foregoing conclusions are supported even considering figures of average employment. Thus while the number engaged per enterprise is generally comparable in both the areas of study, the average employment in the first two categories of trade which are mainly linked to irrigation is particularly higher in the project area.

TABLE NO. 10.6

Percentage distribution of labour employed (paid and unpaid categories)

Category	Project		Control	
	Paid	Unpaid	Paid	Unpaid
1	2	3	4	5
1. Grains	48	52	29	71
2. Agricultural Implements	64	36	71	29
3. General Provisions	17	83	22	78
4. Cloth	12	88	13	87
5. Others	21	79	27	73
TOTAL :	34	66	27	73

4.2. Most of the establishments studied whether in the project or control area are mainly proprietary concerns with no hired labour. This would be observed from figures in Table No. 10.7 which show that over half the establishments in both the areas of study belong to this description. Of the remaining, however, there are relatively more of larger establishments in the project area (8 per cent of the total) that is, those which have reported employment of more than 3 persons. These establishments are conspicuously absent in the control town. The larger establishments again are concentrated in category 1, that is, grain trade.

TABLE NO. 10.7

Distribution of establishments by category of employment

Category	Project										Control									
	Unpaid labour		Paid labour						Total		Unpaid Labour		Paid labour						Total	
			Employing one person		Two to three persons		Over three persons		Establishments				Ests. employing one person		Two to three persons		Over three persons		Establishments	
	No.	percent	No.	percent	No.	percent	No.	percent	No.	percent	No.	percent	No.	percent	No.	percent	No.	percent	No.	percent
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1. Grains	6	23·1	6	23·1	8	30·7	6	23·1	26	100·0	2	33·3	2	33·3	2	33·4	—	—	6	100·0
2. Agricultural Implements & Machinery	2	25·0	2	25·0	2	25·0	2	25·0	8	100·0	—	—	—	—	2	100·0	—	—	2	100·0
3. General Provisions ..	21	72·5	5	17·2	2	6·9	1	3·4	29	100·0	4	57·1	1	14·3	2	28·6	—	—	7	100·0
4. Cloth	13	68·4	6	31·6	—	—		—	19	100·0	5	83·3	1	16·7	—	—	—	—	6	100·0
Others	23	62·2	7	18·9	6	16·2	1	2·7	37	100·0	3	50·0	2	33·3	1	16·7	—	—	6	100·0
TOTAL :	65	54·7	26	21·8	18	15·1	10	8·4	119	100·0	14	51·9	6	22·2	7	25·9	—	—	27	100·0

Capital Investment

5.0. Figures of the size of capital employed in trade again support the main features as indicated above. Thus, investments are higher in the project area in the first two categories of trade while in respect of others, there is higher capital in the control area. Per 1,000 persons, investment is higher by 174 per cent in category 1 in the project area while in comparable categories 3 and 4, it is higher in the control area by 83 per cent and 73 per cent respectively, as compared to the project area (Table No. 10.8). A comparison of average figures also reveals similar trends except that the last category which includes miscellaneous establishments shows slightly higher investment in the project area. Overall, the investment per establishment is 50 per cent higher with irrigation. The investment figures here include the value of business premises (mostly owned) and stocks held. From a further enquiry into the finances of these establishments, it seems that the borrowings of project traders have been relatively larger. In general, borrowed capital constitutes 21 per cent of the total in the project area as against 15 per cent in the control area (Table No. 10.9). In the main, it represents value of stock purchases.

TABLE No. 10.8

Capital investment in Trading establishments

Category	Project			Control		
	No. of establishments	Investment (Rs.)	Investment per 1,000 of population	No. of establishments	Investment (Rs.)	Investment per 1,000 of population
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1. Grains ..	26	31,51,800 (1,21,223)	5,71,495·9	6	3,05,000 (50,833)	2,08,191·1
2. Agricultural Implements & Machinery ..	8	9,19,300 (1,14,912)	42,708·5	2	25,000 (12,500)	3,656·6
3. General Provisions ..	29	1,31,025 (4,518)	51,241·7	7	1,16,800 (16,686)	2,97,959·2
4. Cloth ..	19	2,25,200 (11,852)	77,044·1	6	2,31,000 (38,500)	2,87,313·4
5. Others ..	37	5,16,045 (13,947)	1,80,814·6	6	72,300 (12,050)	1,97,541·0
TOTAL :	119	49,43,370 (41,541)	14,91,212·3	27	7,50,100 (27,781)	12,80,034·1

NOTE: Figures in brackets represent average investment (Rupees per establishment).

TABLE NO. 10.9

Amount borrowed (per cent)

Category	Project	Control
1. Grains	28·1	15·4
2. Agricultural implements & Machinery	—	—
3. General Provisions	37·3	18·8
4. Cloth	32·7	19·5
5. Others	4·1	2·0
Total	20·9	15·2

Stocks

5.1. The larger business in the project area is also reflected in inventory values. These values bear some relationship to the total capital invested and indirectly to the value of sales. In a sense, therefore, the difference in value of stocks could give a more complete measure of differences in size of business. From figures in Table No. 10.10, it would appear that the stocks are considerably higher in the project area that is 75 per cent more per unit than corresponding value in the control area. The most marked increase in the stock position is again in the category of grain trade, where the stocks held are nearly 6 times as large as compared to the corresponding category of traders in Hanumangarh. However, the position is quite the reverse in the categories 3 and 4 where the non-project traders have a better showing. It must be pointed out, that the figures indicated here relate to the stock position as during the period of our enquiry. The data has been gathered on the basis of a single observation. Since the enquiry coincided with a period of brisk farm sales immediately after the *Rabi* harvest, the figures in respect of grain trading got weighted to that extent. The timing of the enquiry, however, has not made any appreciable difference in other categories of trade. Where the turn-over is larger, the stock position is continuously changing and it would be unreal to attribute any permanent difference in trade on the basis of a single observation. The figures however serve to provide a good measure of the difference in volume of business engendered by irrigation. The data here relate to older undertakings.

TABLE No. 10.10

Value of stocks held

(Rs. per establishment)

Category	Project	Control
(1)	(2)	(3)
1. Grains	40,937	7,400
2. Agricultural implements and machinery	56,014	2,000
3. General Provisions	6,060	18,612
4. Cloth	9,978	17,800
5. Others	7,418	2,544
TOTAL :	18,876	10,758

Turn-over

6.0. Besides indices of employment and investment, the volume of business or turn-over is yet another important index in consideration of irrigation benefits. For a more detailed study of the size of business and costs, the sample of establishments was reduced from 146 to 119. This was done primarily to eliminate such of the establishments which had opened their business more recently and for which it would not, obviously be possible to obtain adequate and comparable data for the reference year. This has affected the size of the sample particularly in the control area although the validity of the conclusions are not in any way affected.(2) It would be observed from the figures in Table No. 10.11 that in general the business operations are larger in the project area as reflected in the higher values of turn-over here. In relation to population, the project traders have reported 54 per cent higher sales. In the first category, especially such sales are even higher by 155 per cent in the project area. Per establishment, again, the increase is significant or 121 per cent. Apparently, the larger sales in this category are attributed not so much to increase in the number of establishments as indeed to the larger transactions here. Turn-over in miscellaneous trading, indicated under category 5 is also higher in the project area that is, by 189 per cent as compared to the non-project area. Neglecting agricultural implement shops for which comparable data in the control centre is not available, it is not worthy that in activities not directly to irrigation, the turnover indices are higher in the control area, whether in relation to population or on a unit basis.

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(2) This is so as in presentation of the average value of sales and other data, appropriate corrections have been carried out in population figures. Please see foot-note on page 158 para 6·1 Chapter IX

TABLE No. 10.11

Turnover in Trade : (per 1,000 persons and per establishment)

(In rounded Rupees)

Category	Project				Control			
	No. of Establishments	Total Sales	Sales per 1,000 of popn.	Sales per Establishment	No. of Establishments	Total Sales	Sales per 1,000 of popn.	Sales per Establishment.
1	2	3	4	5	6	7	8	9
1. Grains	25	64,03,923	12,08,515	2,56,157	5	5,78,440	4,73,743	1,15,688
2. Agri-Implements & Machinery	6	14,40,980	89,258	2,40,163	—	—	—	—
3. General Provisions	22	9,89,919	6,23,375	44,996	4	2,14,800	9,58,928	5,33,700
4. Cloth	18	5,85,300	1,72,961	32,517	4	2,01,327	3,75,610	50,332
5. Others	29	19,00,510	8,49,200	65,535	5	89,613	2,93,813	17,923
TOTAL :	100	1,13,20,632	40,64,851	1,13,206	18	10,84,180	26,31,504	60,232

Expenses

7.0. Not only sales but business expenses as well are higher in the commanded area (Table No. 10.12). Here again the increased business outlays are more pronounced in the category of trade handling farm produce within the irrigated area (about 200 per cent more in comparison to non-project area). In respect of other categories of goods, however, business expenses are higher in the control centre. In the latter case, that is, categories 3 and 4, the expenses are higher in the control area by 46 per cent and 55 per cent respectively as compared to the project trade. These conclusions hold good whether the items are related to size of the population or in terms of average establishment.

7.1. A further analysis would indicate that both in the project and control areas stocks account for the largest proportion of working expenses. For instance, this item constitutes as much as 95 per cent of the total expenditure (Table No. 10.13). Differences, however, are noticeable between categories of trade although, not of a magnitude as to require special mention. Wages and salary payments constitute a small proportion to total business expenses although relatively such expenses are higher in the project area considering all categories of trade. In relation to total expenses again tax payments are somewhat higher in project area particularly in the miscellaneous trade which is attributable to excise duties paid by wine traders here. On the contrary, the expenditures included under 'others' which mainly include transport costs, are higher in the control area. The relative significance of these items, however, changes between different categories of trade. In considering above figures, two important limitations need be kept in view. Firstly, the figures of value of stocks or material purchases, represent the residuary cost after allowing for all items of expenditure plus such value under profit as reported by the traders. It is likely that certain other minor expenditures as well might have been included under this item, which could not be specifically reported. Data regarding this item could not be collected independently. For one thing, investments are made periodically and in the case of smaller establishments which constitute the bulk of the sample and for which no recorded data was available, such an attempt even otherwise had proved difficult. It is unlikely however that this in itself would materially affect the pattern of expenditure or the validity of conclusions pertaining thereto.

7.2. It has been observed that wage and tax payments are higher in the project area. A fuller comparison of these important items could not be made for want of further details as for instance, breakdown of tax payments by recepient authority. On an average for all categories of trade, it is seen that project traders paid out 241 per cent higher wages and 276 per cent higher taxes. These provide a measure of the benefits of irrigation. Between different categories the difference varies (Table No. 10.14).

TABLE No. 10.12

Expenditure, Sales and Net income in Trade

(Rupees per 1,000 of population)

Category	No. of Establishments		Expenditure		Sales		Net Income	
	Project	Control	Project	Control	Project	Control	Project	Control
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1. Grain	25	5	11,63,375 (2,46,589)	4,62,350 (11,291)	12,08,515 (2,56,157)	4,73,743 (1,15,688)	45,140 (9,568)	11,392 (2,782)
2. Farm Implements and Machinery ..	6	—	82,811 (2,07,785)	— (—)	89,258 (2,40,163)	— (—)	12,034 (32,378)	— (—)
3. General Provisions	22	4	73,462 (41,394)	1,37,267 (50,240)	6,23,375 (44,996)	9,58,928 (5,33,700)	49,914 (3,603)	61,790 (3,460)
4. Cloth	18	4	1,56,426 (29,408)	3,36,935 (45,150)	1,72,961 (32,517)	3,75,610 (50,332)	16,534 (3,108)	38,671 (5,182)
5. Others	29	5	7,68,273 (59,290)	2,55,127 (15,563)	849 (65,535)	2,93,813 (17,923)	80,927 (6,245)	38,688 (2,360)

NOTE : Figures in brackets represent average per establishment.

TABLE NO. 10.13

Expenditure under different Items, percentage to total expenses and net Income

(In Thousand Rupees)

Particulars	Grains		Ag. Imp.	General Provisions		Cloth		Others		Total	
	Project	Control	Project	Project	Control	Project	Control	Project	Control	Project	Control
1	2	3	4	5	6	7	8	9	10	11	12
1. Rent	34·1 (0·5)	2·1 (0·4)	10·0 (0·8)	8·6 (0·9)	2·8 (1·4)	4·9 (0·9)	2·5 (1·4)	12·6 (10·7)	1·3 (1·7)	70·2 (0·7)	8·7 (0·9)
2. Wages	72·2 (1·2)	4·9 (0·9)	111·7 (9·0)	5·9 (0·6)	3·7 (1·8)	3·3 (0·6)	— —	19·0 (1·1)	8·6 (3·3)	212·1 (2·0)	11·2 (1·1)
3. Light	5·0 (0·1)	0·3 (—)	1·8 (0·1)	1·0 (0·1)	0·4 (0·2)	0·8 (0·2)	0·3 (0·2)	1·9 (0·1)	0·2 (0·3)	10·5 (0·1)	1·2 (0·1)
4. Taxes	11·9 (0·2)	0·9 (0·2)	0·6 (—)	3·7 (0·5)	3·4 (1·7)	1·4 (0·3)	0·9 (0·5)	112·8 (6·6)	1·1 (1·4)	130·4 (1·2)	8·3 (0·6)
5. Interest	42·4 (0·7)	1·5 (0·3)	— (—)	— (—)	0·9 (0·4)	4·9 (0·9)	1·5 (0·8)	0·5 (—)	— (—)	47·8 (0·5)	3·9 (0·4)
6. Stocks	5,949·4 (96·5)	549·4 (97·3)	1,089·5 (87·4)	882·6 (97·9)	186·4 (92·8)	507·3 (95·8)	170·6 (94·5)	1,562·5 (90·9)	70·9 (91·1)	9,991·3 (94·5)	977·3 (95·4)
7. Others .. .. (Transport etc.)	49·9 (0·8)	5·4 (0·9)	33·1 (2·7)	8·9 (1·0)	3·5 (1·7)	6·8 (1·3)	4·8 (2·6)	10·1 (0·6)	1·7 (2·2)	108·8 (1·0)	15·4 (1·5)
8. Total Expenses ..	6,164·9 (100·0)	564·5 (100·0)	1,246·7 (100·0)	910·7 (100·0)	201·1 (100·0)	529·4 (100·0)	180·6 (100·0)	1,719·4 (100·0)	77·8 (100·0)	10,571·1 (100·0)	1,024·0 (100·0)
9. Sales	6,404·0	578·4	1,441·0	990·0	214·8	585·3	201·3	1,900·5	89·6	11,320·8	1,084·1
10. Net Income	239·1 (3·7)	13·9 (2·4)	194·3 (13·5)	79·3 (8·0)	13·7 (6·4)	55·9 (9·6)	20·7 (10·3)	181·1 (9·5)	11·8 (13·2)	749·7 (6·6)	60·1 (5·5)

NOTE : Bracketed figures against item 10 represent percentage to sales against item 9. Other bracketed figures (items 1 to 7) indicate percentage to total expenses (Item 8.)

TABLE NO. 10.14

Wages and Taxes in Trading establishments

(In Rs.)

	Project					Control				
	No. of Establishments	Total wages paid	Wages per 1,000 population	Total taxes paid	Taxes per 1,000 population	No. of Establishments	Total wages paid	Wages per 1,000 population	Total taxes paid	Taxes per 1,000 population
1	2	3	4	5	6	7	8	9	10	11
1. Grains	25	72,172 (2,887)	13,620	11,866 (475)	2,239	5	4,880 (976)	3,997	860 (172)	704
2. Agr. Implements & Machinery	6	1,11,720 (18,620)	6,920	550 (92)	34	—	—	—	—	—
3. General Provisions	22	5,820 (265)	3,665	3,686 (168)	2,321	4	3,720 (930)	16,607	3,389 (847)	15,129
4. Cloth	18	3,340 (186)	987	1,405 (78)	415	4	—	—	900 (225)	1,679
5. Others	29	18,980 (665)	8,481	1,12,843 (3,891)	50,421	5	2,580 (516)	8,459	1,081 (216)	3,544
TOTAL :	100	2,12,032 (2,120)	76,133	1,30,350 (1,304)	46,804	18	11,180 (621)	27,136	6,230 (346)	15,121

NOTE : Figures in brackets represent average per establishment.

There is, no paid labour in category 4 in the control area. Miscellaneous establishments included in the last category although do not register much variation in respect of wages, show significant difference under tax payments. Thus, the tax payments in this category are nearly 13 times the corresponding value in the control area. The average expenditure as well under the above items show similar trends for different categories of trade although the percentage difference is not necessarily of the same order.

7.3. The generally higher expenses in relation to total sales in the control area have depressed business profits. This is evident from figures of profits or net income expressed as percentage of sales. For instance, traders in the project area have reported profits equivalent to 6.6 per cent of the value of gross sales while the corresponding proportion in the control area is 5.5 per cent. In other words, for similar expenditure or investment, the project traders reap a net additional gain of 1 per cent. The profits are particularly highest in the category 2 in the project area while they are a maximum in category 3 in the control area. It may be mentioned that the figures of profits are those reported by the traders themselves. Although considerable care was taken to conceal the identity and anonymity was assured, an element of under-rating of these values has inevitably crept in. This is also confirmed by cross-checks regarding sales and commissions earned mainly in grain transactions. The order of difference, thus, would be even higher than represented by above figures and if any, would be more favourable to project traders.

Gross and net benefits from trade

8.0. From the foregoing analysis, it is possible to conclude that the benefits of irrigation are most pronounced in such trading activities as are closely related to farm production. A closer estimation of benefits arising in this category of trade may, therefore, be attempted on the basis of sample data. As in the case of processing industries, the trade benefits may also be expressed in terms of additional expenditure incurred by businessmen over and above the value of farm products and materials entering trade. Figures in Table No. 10.15 indicate the size of such benefit per thousand of population and distributed by the main recepients. The overall increase in the value added amounts to 261 per cent in the project area. The principal items under which such an increase in value is well pronounced are profits, rent, interest and wages. The percentage increase in value under rent and interest is nearly four-fold while profits show a three-fold increase in comparison to control area. Wages and taxes are higher by 241 per cent and 219 per cent respectively. These estimates convey a measure of the benefits arising from larger trade in farm products and those materials required for farm production.

TABLE No. 10.15

Distribution of additional incomes in Trading establishments (Agricultural commodities)

(Average value and for 1,000 of population)

Particulars	Project (25 establishments)		Control (5 establishments)		Percentage increase
	Total value	Per 1,000 of population	Total value	Per 1,000 of population	
1	2	3	4	5	
1. Wages	72,172	13,620	4,880	3,997	240·8
2. Profits	2,39,198	45,140	13,910	11,392	296·2
3. Rent Interest	76,477	14,432	3,639	2,980	384·3
4. Taxes	11,866	2,239	860	704	218·0
5. Miscellaneous	53,776	10,337	5,712	4,678	121·0
Total	4,54,489	85,768	29,001	23,751	261·1

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CHAPTER XI

SUMMARY OF CONCLUSIONS

1.0. The principal objective of this study of a major irrigation project has been to determine the total impact of irrigation as distinguished from the purely financial or commercial benefits which can be assessed in terms of return on investment. As the report of U.N. Panel of experts aptly observes, "it is conceivable that a project which failed to pass the broader test of economic feasibility could be financially feasible and an 'economic' project could be commercially not feasible".(1) In the concluding chapter, the more important indicators are brought together to present an integrated picture of the effects of canal irrigation. The first sections presents the main conclusions of our studies concerning, farm business, agricultural, labour, industry and trade. The next section deals with the financial aspects, particularly the revenue effects or "indirect" financial returns, which have not been touched upon elsewhere in the report. In the third and final section are presented the overall estimates of benefits and costs.

I. SUMMARY OF CONCLUSIONS

2.0. The introduction of canal irrigation in an area which is characterised by extreme aridity and the colonisation of the tract largely by a peasantry gifted with enterprise and resourcefullness have been powerful factors in ensuring that the benefits of irrigation will be obtained in abundant measure. A general study of village economy and a more detailed examination of the various aspects of farms, confirm that such benefits have been secured.

General effects on farm economy

2.1. The immediate impact of irrigation is in stimulating resource-use and reducing the extent of under-utilisation of physical and human resources. Land use has been undoubtedly increased considerably. On the size of farms, however, irrigation does not seem to have much effect. The average size of holdings in both the areas of study is comparable, although the smaller holdings that is, below 10 acres apparently are more in the project area, being 37 per cent of the total as against 11 per cent in the uncommanded area. This need not, however, be considered as reflecting any trend towards smaller holdings being associated with irrigation. The general concentration of holdings in both the areas is in the size groups 10 to 25 acres.

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(1) United Nations : Integrated River Basin Development, Chapter III, Page 18.

2.2. Data on land holdings suggest that in the commanded area greater part of the land is under owner-cultivation that is 62 per cent farms with 70 per cent of the area while in the Barani area 62 per cent of the farms are under tenant cultivation with 57 per cent of the area. The system of leasing land also is markedly different in both the areas. While share cropping is prevalent in the project area, greater part of land is held on lease from Government in the Barani area. The higher value of land in the commanded area (nearly 4 times the price prevalent in the Barani area) reflects the keen demand for ownership of land and the better financial resources of the colonisers.

Crop pattern

2.3. The most significant effect of irrigation is a shift towards cultivation of more cash crops and the replacement of inferior crops by better varieties. Irrigation has made possible cultivation of a wet crop like paddy in this semi-arid region and has promoted a system of diversified cropping. The principal irrigated crops were cotton (23 per cent), wheat (29 per cent), fodder (16 per cent) and grams (11 per cent). Rice and sugar-cane also covered an area of 1.4 per cent and 2.5 per cent respectively. The cotton acreage was higher in the non-perennial zone. Outside the colony, however, wheat and gram were the most important crops, cash crops accounting for about 13 per cent of the area while oilseeds and mixed crops nearly 20 per cent of the area each. , With assured water supply more crops were raised and the total acreage increased. In the absence of irrigation there was greater reliance on one crop and the extent of crop failure was also higher. Irrigation had also helped to increase yield of crops considerably. For instance, the average yield per acre of wheat and oilseeds and mixtures had more than doubled with irrigation while even in the case of grams which was a bumper crop in the Barani area there was an increase of 21 per cent with irrigation.

Effects on Investment

2.4. Provision of irrigation has provided favourable conditions for productive investment. Irrigation had made it necessary to increase both fixed and operating capital of the farmers. The value of fixed capital (that is, land and farm house, equipment and livestock) was seven times larger with irrigation, although the extent of increase varied between perennial and non-perennial irrigation, the investment being lower in the latter. The principal item of investment was obviously land which accounted for 88 per cent of the total capital, while livestock and implements accounted for 6 per cent and 4 per cent respectively in the commanded area. In the absence of irrigation investment in land was less or about 62 per cent although on an item like livestock it was considerably higher or 34 per cent. Even excluding land, the investment difference was large, being about 2½ times higher with irrigation.

2.5. Investment in implements was significantly higher with irrigation or 13 times the level on barani farms. More farmers in the project area had better implements and the larger investment under this head may be associated with the higher capital formation with irrigation. On the contrary, in the uncommanded area farmers had very little use even for a fairly common implement like the iron plough. Value of livestock held per acre was again higher with irrigation that is, by 39 per cent.

Effects on farm business

2.6. The increased net earnings from farming provide a measure of the primary (direct) benefits of irrigation, while the additional outlays and expenses termed 'associated' costs define the indirect benefits. In respect of both, the sample data suggest significant increases with irrigation. Firstly, output of all crops was observed to be nearly three times larger with irrigation or Rs. 166 per acre as against Rs. 57 in the uncommanded area. The increase in total expenses under irrigation also was three times the level in the uncommanded area. More specifically irrigation had induced greater spending on farm materials, fertilisers and manures besides other overheads. The net income or profits in absolute value amount to Rs. 17.4 per acre with irrigation while without irrigation it was Rs. 9.3 per acre. In percentage terms this represents an increase of over 87 in farm profits under conditions of irrigated agriculture.

2.7. Considering farm business income including crops and livestock enterprises which represent a measure of the profits in farming wages for farmer's own labour interest and rent on owned capital, it was observed that such income was Rs. 55 per acre with irrigation. In the absence of irrigation farm business income amounted to Rs. 33 per acre that is, it was higher by 35 per cent with irrigation. Family labour income which includes over and above profits the return to farmer's own labour was higher by 46 per cent with irrigation that is Rs. 45 per acre in the commanded zone as against Rs. 30.8 in the uncommanded zone. The effects of irrigation were well pronounced even in terms of other indices as investment income etc.

Effects on employment

2.8. Among the more important indirect benefits, increased employment of farm labour merits special mention. The average utilisation of human labour per holding was 390 mandays in the irrigated area as against 177 in the unirrigated. The employment was the least on small farms and increased with the size of the holding. The employment was higher in the irrigated area mainly under the category of "hired labour" which constituted 47 per cent of the total mandays on the irrigated farms as against nearly 10 per cent on the uncommanded farms. The utilisation of bullock labour on the irrigated farms was twice as much as on barani farms.

2.9. The enquiry into the conditions of farm labour revealed that on an average the workers in the project area were employed for 192 days in the year while in the barani area the average number of work days was 145 of which nearly 48 per cent were recorded outside the village that is, mostly in the commanded villages. Labour in the project villages was employed for greater part of the year. For instance 80 per cent of the workers were employed for periods varying from 50 per cent to 100 per cent and an equal proportion of workers in the Barani villages were employed for periods varying from 33 per cent to 67 per cent of the time. Wage rates being generally the same in both the areas, the higher earnings of project labour reflected the longer period of employment.

Secondary benefits (Industry)

2.10. The benefits of irrigation are not confined to the farms under the immediate command of the canal but are transmitted by a series of chain reactions to the rest of the economy. In a sense the larger the net addition to the total farm output that an irrigation project makes possible, the greater the scope for secondary operations concerned with the processing, transporting and distributing such farm products. The results of an enquiry into industrial and trading establishments in selected centres located within the canal zone and outside land support to these assumptions.

2.11. Generally there was more of industrial activity and services in the canal area and even with relatively smaller population the project towns were able to support more of industrial activity. Perhaps the influence of the canal irrigation was felt more in the development of resource-based industries, particularly such processing facilities as cotton ginning and sugar factories. The canal thus has promoted the industrial development of the area. The data further indicated that the average size of industrial establishment in the project area was larger in terms of invested capital. In comparison to the establishments in the control area, it was larger by 51 per cent in respect of processing units and over 300 per cent for engineering industries. The project industries in general provided greater employment also, although there were marked variations between the different categories of industries. Skilled labour and "paid" labour were relatively larger in the project industries than in the control industries.

2.12. From a study of production costs and output data it appears that expenses were generally higher among the project units. For all the categories taken together, the cost per unit was higher by as much as 95 per cent. The higher production costs were mainly visible in the processing group and in respect of raw materials. The wage costs were comparatively low both in the project and control areas mainly due to the predominance of unpaid or 'own account' workers. On the contrary, expenditures on fuels and repairs etc. were larger among the control industries.

2.13. The secondary benefits may be expressed in terms of increase in value added by manufacture or processing activity. Figures of net value added are much higher in the project sample as compared to the control sample. This is particularly so in the processing industries where the net value added per establishment amounts to Rs. 48,000 as against Rs. 970 in the control area. The breakdown of the value figures by the principal components indicates that the larger share that is, 76 per cent is accounted for by net value which includes profits, wages to labour of the operator etc.

2.14. Expressing the secondary benefits as percentage profit that may be distributed to farm products under processing, it is observed that it varies from a negative return of 7.9 per cent for cotton to over 22 per cent for wheat. The latter may be compared with 3.9 per cent as observed in the control group of industries. In the case of cotton it was observed that one firm made heavy investments in raw materials which resulted in net loss.

Trade

2.15. A survey of business establishments in selected centres has also disclosed results somewhat similar to those in respect of industries. It was found that the project area supported greater business activity. Even relatively smaller towns were able to support larger business activity particularly in the category of trade in foodgrains and other agricultural products. A general count of business establishments disclosed that there were slightly more of largersized establishments in the project area. Further the gross turn-over or sales per establishment was observed to be nearly double that of the establishments outside the colony. This was true of trade in agricultural goods because in the other categories that is, general merchandise, clothing etc., the turnover was higher in establishments outside the colony. Besides, the value of stocks held on an average was nearly six times larger in the project area. The employment also was slightly higher among the project establishments while in the control area there was more of unpaid labour.

2.16. Expenses were generally higher among the project establishments and at the same time profits also were higher. The most significant item of expenditure was the outlay on stocks. This is followed by wages and tax payments. The net profits in relation to total sales amounted to 6.6 per cent in the project area as against 5.5 per cent in the control area. Expressing the benefits from trade in terms of additional expenditure incurred over and above the value of farm products entering trade, on an average the increase in the value added in the project area was particularly significant in respect of profits and returns to property in the form of higher rents and interest income which was three times that in the control area. Wages and salaries were twice as large.

II. INDIRECT FINANCIAL RETURNS

3.0. It is generally recognised that investment in an irrigation project pays itself through not only its direct returns that is, water rates but also through increase in revenue receipts to State and local authorities. The underlying assumption, of course, is that irrigation is a prime mover and facilitates development in other directions. Development in the secondary and tertiary sectors might not bear any functional relationship to the expansion in the primary sector but a part of the benefits or additional incomes created in the rest of the economy are reflected in larger yields of revenue to the Government which has undertaken the investment. In so far as such increase in revenue receipts could not have taken place otherwise, there is justification for attributing either a part or the whole of such increase in revenues to the investment in the project. It is true, that to sustain the higher level of economic activity generated by initial investment in the project, subsidiary investment in social services becomes necessary and the costs of administration may also go up. On the whole, however, the increase in tax resources may well be greater than that in the expenditure, leaving a larger net surplus.

3.1. Estimation of the indirect financial returns is subject to both conceptual and practical limitations. Firstly, it involves fairly detailed assessment of various revenue and enterprise receipts to local State and Central Governments which is itself a task of no small magnitude. We could not attempt this fully within the time limit of our study. For instance, no information could be obtained regarding receipts from State enterprises like Railways, Posts and Telegraphs etc. in the region and in respect of other taxes it was not possible to obtain detailed estimates and breakdown of data to help establish their relationship to irrigation. Even more difficult is the process of isolating the effects of irrigation because increase in revenue resources has been brought about as much by investment in canal as by other complementary investments and the general expansion of economy in the area. Development of transport and communications and factors like large scale transfer of population and rehabilitation of displaced persons in the area are factors the effects of which cannot be disentangled from those of others.

3.2. The Committee of Direction, recognising these difficulties, suggested that information regarding receipts of public authority might be gathered for administrative units. Notionally it would be necessary to determine the share due to the area under study. By comparing these with receipts in non-irrigated or 'control' areas, receipts due to irrigation could be roughly determined. Accordingly, we have analysed such items as land revenue and Central Excises. For other State taxes, estimates have been presented for the District as a whole.

Land revenue

3.3. As a result of irrigation, the yield of land revenue increased considerably in the area. Farm business data showed that the yield compared to the barani area was quite considerable.

3.4. The figures in Table No. 11.0 indicate that on an average the revenue yield from the colony is nearly twice as large as compared to the rest of the District.(2) Percentage collections as well as significantly higher being about 85 per cent in the colony as against 70 per cent in the rest of the District. Nearly 2/3rds of the total land revenue collections of the District arise in the colony area although, in terms of cultivated area, the colony has a third of the area of the District. In terms of cultivated area, land revenue per acre amounts to Rs. 3 in the colony as against Rs. 0.9 outside the colony (Table No. 11.1). If, however, only cropped area is taken into account, the average rate in the colony is even higher.

3.5. It could be conceived that even in the absence of irrigation, increases in the revenue would have taken place through normal revision of assessment. In the case of Gang canal, however, it was observed that the increase over the years in the dry assessment has been negligible. The 1928 Settlement fixed the dry rate at A.4 P. 6 per occupied bigha or Rs. 0.45 per acre and the 1946 Settlement increased the rate only very slightly that is, to A. 4 P. 10 or an overall increase of 8 per cent. On the contrary, in the colony area both land revenue rates and water charges have substantially increased. The system of assessment also differs between the colony and the non-colony areas. Thus while for Barani land, the assessment is fixed for each village irrespective of the fact whether the land under question is cultivated or not, a system of fluctuating assessment prevails in the colony area. The rates vary between different chaks and are charged on the area actually under matured crops for each crop season. They also vary as between perennial and non-perennial Irrigation.

3.6. Further, while the collections have been steady around Rs. 39 lakhs, fluctuations in yield in the non-colony areas are quite marked. The variation here is between Rs. 8 lakhs in 1953-54 to over Rs. 35 lakhs in the year 1958-59 (Table No. 11.0). The greater stability in revenue is further confirmed by figures in Table No. 11.2 which show the extent of remissions and suspensions. Within the canal tract the assessments remitted on suspended amount to less than 1 per cent during the period while outside the colony these amounted to about 1/4th the assessment and in individual areas, the percentage remissions may well be over 2/3rds. Revenue remissions are mainly in Anupgarh area in the colony which has relatively less commanded area and is located at the tail end of the canal system.

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(2) The figures here are inclusive of arrears.
Data for the year 1955-56 was not available.

TABLE NO. 11.0

Assessed Land Revenue and collections (Tehsil-wise)

(Rs. lakhs)

Tehsils	1953-54		1954-55		1956-57		1957-58		1958-59		Average 1953-59		
	Demand	Collections	Demand	Collections	Demand	Collections	Demand	Collections	Demand	Collections	Demand	Collections	Per cent
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Colony													
Ganganagar	9·69	8·46	9·89	8·60	9·86	7·81	10·11	8·55	11·56	10·59	10·22	8·80	86·10
Karanpur	7·00	6·46	7·27	6·81	6·76	5·72	7·21	6·43	7·28	6·61	7·10	6·41	90·28
Padampur	6·40	5·63	6·54	5·89	6·69	5·04	7·76	7·43	6·33	6·13	6·74	6·02	89·31
Raisinghnagar	7·85	6·67	7·67	5·98	7·93	6·26	8·17	6·95	9·03	7·80	8·13	6·73	82·77
Anupgarh	4·66	3·23	4·90	3·86	6·06	4·69	4·91	3·76	6·84	5·40	5·47	4·19	76·59
SUB TOTAL	35·60	30·45	36·27	31·14	37·30	29·52	38·16	33·12	41·04	36·53	37·67	32·15	85·34
Non-colony													
Suratgarh	1·70	1·16	2·72	0·99	8·35	6·01	5·29	3·48	17·24	11·02	7·06	4·53	64·16
Hanumangarh	3·47	3·45	7·70	4·85	6·12	4·25	17·61	16·26	15·53	14·36	10·09	8·63	85·53
Nohar	3·01	0·62	5·70	2·73	7·52	4·99	2·63	0·99	13·16	6·43	6·40	3·15	49·23
Bhadra	3·83	2·73	3·02	2·09	3·42	2·94	0·95	0·61	4·94	3·26	3·23	2·33	72·13
SUB TOTAL	12·01	7·94	19·13	10·66	25·41	18·19	26·48	21·34	50·8	35·07	26·78	18·64	68·85
TOTAL (District)	47·61	38·41	55·51	41·80	62·71	47·71	64·64	54·46	91·91	71·60	64·46	50·80	78·80

TABLE NO. 11.1

Incidence of Land Revenue

Tehsils	Land Revenue (in lakh) Rupees)	Cultivated area (in lakh acres)	Rupees per acre
1	2	3	4
Colony			
Ganganagar	8·80	3·20	2·75
Karanpur	6·41	1·87	3·43
Padampur	6·02	1·94	3·10
Raisinghnagar	6·73	2·50	2·69
Anupgarh	4·19	1·09	3·84
SUB TOTAL	32·15	10·60	3·03
Non-colony			
Suratgarh	4·53	4·35	1·04
Hanumangarh	8·63	6·52	1·32
Nohar	3·15	6·61	0·48
Bhadra	2·33	3·87	0·60
SUB TOTAL	18·44	21·35	0·87
TOTAL (District)..	50·80	31·95	1·59

NOTE : Figures in Cols. 2 and 3 are averages for the years 1953-54, 1954-55, 1956-57 and 1957-58.

Local Cesses

3.7. The benefits to local authority are directly in proportion to the increase in land revenue since these cesses are charged to revenue. In the Gang canal area the District Board cess is levied at the flat rate of 6¼ per cent over and above the demand under land revenue and rent and no distinction is made between irrigated and unirrigated areas. Figures of cesses relate to the District as a whole and the average collections are a little over Rs. 2 lakhs (Table No. 11.3). As land revenue in the colony bears a high proportion to the total yield from the district, that is, about 2/3, the proportion of cess arising in the colony as well, would be as much. On this assumption, the yield of cess attributed to the colony area may be around Rs. 1.3 lakh. No account here has been taken of realisations from cash rents and other grazing fees especially levied in the Barani area.(3)

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(3) In addition, *Pachotra* (remuneration to Lamberdar) is charged on land revenue and water rate at the rate of 3.50 per cent and 3.12 per cent respectively in the colony while it is at a uniform rate of 5 per cent in the Barani area. The increased collections under this source cannot however be taken into account in benefit calculations as these represent merely charges for services rendered.

TABLE NO. 11.2

Total assessed Land Revenue and extent of remissions and suspensions

(Rs. Lakhs)

Tehsils	1953-54		1954-55		1956-57		1957-58		Average	
	Demand	Suspension and Remission	Demand	Suspension and Remission	Demand	Suspension and Remission	Demand	Suspension and Remission	Demand	Suspension and Remission
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Colony :										
Ganganagar	8·09	—	8·67	—	8·38	—	8·34	0·29 (3·5)	8·37	0·07 (0·84)
Karanpur	6·24	—	6·73	—	6·28	—	6·19	0·01 (0·2)	6·36	0·003 (0·51)
Padampur	5·36	—	5·77	—	6·08	—	6·22	0·11 (1·8)	5·86	0·03 (0·51)
Raisingh Nagar	6·61	—	6·49	—	6·73	-	6·65	0·15 (2·3)	6·62	0·04 (0·60)
Anupgarh	3·29	—	3·79	0·33 (8·7)	4·55		3·83	0·30 (7·8)	3·86	0·16 (1·1)
SUB TOTAL	29·58	—	31·45	0·33 (1·05)	32·02		31·23	0·86 (2·8)	31·07	0·30 (0·97)
Non-Colony :										
Suratgarh	1·96	—	2·74	1·99 (72·6)	3·00	—	7·54	4·60 (61·00)	3·81	1·65 (43·31)
Hanumangarh	3·83	—	3·96	—	3·80	—	17·59	1·85 (10·5)	7·29	0·46 (6·31)
Nohar	1·11	—	4·17	1·45 (34·8)	4·61	—	4·35	4·24 (97·5)	3·56	1·42 (39·88)
Bhadra	1·93	—	2·71	0·94 (34·7)	2·43	—	2·41	1·93 (80·1)	2·37	0·72 (30·37)
SUB TOTAL	8·83	—	13·58	4·38 (32·3)	13·84	—	31·89	12·62 (39·6)	17·03	4·25 (24·95)
TOTAL (District) ..	38·42	—	45·03	4·71 (10·5)	45·86	—	63·12	13·48 (21·4)	48·11	4·55 (9·46)

NOTE : Figures in brackets represent percentage of assessed revenue remitted or suspended.

TABLE No. 11.3

Demand and Collection of District Board Cess

Year	Demand (Rs.)	Collections (Rs.)	Percentage collection
(1)	(2)	(3)	(4)
1953-54	2 40,000	1,15,355	48·06
1954-55	2,00,000	2,76,600*	138·30
1955-56	2,40,000	2,01,300	83·87
1956-57	2,62,356	2,62,266	99·96
1957-58	2,60,000	2,47,232	95·08
Average	2,40,471	2,20,551	91·72

*Arrears of last year recovered in excess.

Central Excises

3.8. In regard to Central Excises, it is seen on a comparison of the figures for the 3 years ending 1958-59 that, on an average, the colony contributes Rs. 28.6 lakhs which is nearly 93 per cent of the total collections (Table No. 11.4). This does not take account of cost of collection. Assuming that such cost represents 4 per cent of collections, the net yield from this source would be Rs. 27.5 lakhs. The difference would be even larger, if the collections from Anupgarh which are shown under the non-colony area are transferred to the colony area. Further, the revenue from sugar excise alone accounts for Rs. 13.6 lakhs, which is half the colony yield or 44 per cent of the district collections. This is an item which is entirely attributable to canal irrigation. Further, commodity-wise break-up of data is not available but there is reason to believe that a substantial part of the income under this source is derived from duties on imported and locally manufactured liquors, the consumption of which is sizeable in the colony.

TABLE No. 11.4

Percentage distribution of total collections of Central Excises

(Rs.)

Range	1956-57	1957-58	1958-59	Average
(1)	(2)	(3)	(4)	(5)
1. Ganga Nagar Circle : (Ganga Nagar, Karanpur, Padampur and Raisingh Nagar)	18,38,430 (91·01)	36,33,451 (94·23)	31,05,513 (91·58)	28,59,131 (92·56)

(1)	(2)	(3)	(4)	(5)
2. Hanumangarh Circle : (Bhadra, Nohar, Hanumangarh, Suratgarh, Anupgarh)	1,81,568 (8·99)	2,22,466 (5·77)	2,85,617 (8·42)	2,29,884 (7·44)
TOTAL (District) ..	20,19,998 (100·00)	38,55,917 (100·00)	33,91,130 (100·00)	30,89,015 (100·00)
	Sugar Excise only			
Ganga Nagar	5,49,244 (27·19)	19,42,274 (50·37)	15,86,955 (46·80)	13,59,491 (44·01)

NOTE :—Figures in brackets are percentages to the total Revenue.

III. BENEFIT-COST RATIO

4.0. Table No. 11.5 shows the magnitude of the primary benefits represented by additional income from crop production. The estimate has been derived by blowing up the sample data of farm business to the total irrigated area under the command of the Gang canal. The canal, has a total culturable area of 7.58 lakh acres, of which the area actually irrigated was 7.24 lakh acres. For calculation of total benefits the latter area was adopted since it provided for a complete count. In calculating the aggregate production the average output and input figures have been applied to the commanded area distributed between different farm groups in the same ratio as obtaining in the project sample. For working out equivalent production under conditions without irrigation, the universe was distributed in different farm groups in the same ratio as observed in the sample holdings in the Barani area. The increase in crop income after taking account of all the additional expenses arising from irrigation thus gives a measure of the total direct benefit accruing to the farm population. As will be seen, this works out to a little over Rs. 44 lakhs. This is nearly 17 per cent of the capital outlay on the canal. The percentage would, of course, be reduced if the investment costs are adjusted to present prices.

TABLE NO. 11.5

Overall estimates

	(Rs.)
A. *Gross Crop production*	
(1) With canal irrigation	12,73,56,168
(2) Without canal irrigation	4,04,54,703
(3) Additional output due to canal irrigation (1-2)	8,69,01,465
B. *Cost of production to the economy*	
(1) With canal irrigation	11,64,15,383
(2) Without canal irrigation	3,39,39,759
(3) Additional cost due to canal irrigation (1-2)	8,24,75,624
C. Net increase in income from crop production attributable to irrigation (A3-B3)	44,25,841

4.1. The above estimates take into account only the additional farm expenses (associated costs) arising from irrigation. Adding to this annual project costs including operation and maintenance charges, interest on capital outlay etc., the overall benefit-cost ratio is obtained. This ratio as will be seen in Table No. 11.6 is 1.4 is to 1 which is suggestive of the productive character of investment in this canal. In working out the ratio we had taken interest at 5 per cent of capital outlay as per present productivity rate. Depreciation at 2 per cent has been calculated on straight-line method, that is, assuming the life of project as 50 years. If the ratio is calculated with reference to the sum-at-charge which in the case of Gang canal is less than the capital outlay, the ratio would turn out to be more favourable than indicated here. The benefit-cost ratio could be expressed in several ways. For the purpose of this study we have followed the practice currently in use in U.S.A.(4) Indeed if the indirect primary benefits are also included, that is, increase in farm wages and the additional interest and rental income in the project area estimated on the same basis as additional farm production, the benefit-cost ratio would improve further. In considering the ratio the peculiar conditions obtaining in the project area during the year of enquiry and other limitations of the study to which attention was drawn in the earlier chapters should be borne in mind.

TABLE NO. 11.6

Benefit-cost ratio

Particulars	Rs.
(1)	(2)
1. *Direct Benefits :*	
(*a*) Increase in gross farm income	8,69,01,465
(*b*) Increase in farm costs	8,24,75,624
(*c*) Annual benefits (a-b)	44,25,841
2. *Costs :*	
(*a*) Operation and maintenance	13,04,549
(*b*) Interest at 5% on capital cost of Rs. 2·67 crores	13,35,540
(*c*) Depreciation at 2%	5,34,216
(*d*) Total costs (a+b+c)	31,74,305
3. *Benefit Cost Ratio*	1·4 : 1

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(4) The benefit-cost ratio follows the general method of computation prescribed by the Bureau of Reclamation (USA) Manual. The over all benefit-cost ratio is derived by taking the quotient of annual benefits divided by annual costs. The annual benefits are net of private costs. On the cost side, there are both project and private costs. The former include interest and amortization of net project investment, operation and maintenance cost and provision for replacement of existing nonproject facilities. The private direct costs include interest on land development, feed and initial livestock, interest and amortization of investment in buildings, machinery etc. and farm operating costs.

Negative benefits

5.0. An assessment of the more important social effects was outside the purview of present study. Some of these "social costs" are associated factors of development of irrigated agriculture. Factors like rise of subsoil water, aggravation of water logging conditions and increase in incidence of malaria have a direct relationship with the spread of canal irrigation. Others like village and group tensions, increase in crime, drinking etc. are rooted in more complex sociological phenomena. Nevertheless, increase in agricultural production has facilitated greater spending on liquor and entertainments. Enquiries from the farmers and older residents of the colony showed that this evil has grown with irrigation. From a scrutiny of the figures of investment and sales of wine-shops enumerated in the selected urban centres, it appears that the average sales are higher among establishments in the colony. For instance, while capital investment was comparable in the two areas, the sales per shop were higher in the project area or Rs. 1.2 lakh as against Rs. 52,000 in Hanumangarh. This is a rough index of the greater spending in the colony on liquor and other intoxicants. Associated with this is the problem of crime. The crime rate is said to be the highest in this District among all the Districts in the State and not infrequently water disputes provide the immediate provocation. A comparison of statistics of revenue cases also suggests that on an average, the number of revenue cases in colony tehsils is more as compared to those outside the colony.

5.1. The increase in subsoil water level and the attendant agricultural and public health problems are often associated with canal irrigation. In the Gang Canal colony available evidence indicates a rising water level. According to the Settlement Report of 1946, the water table increased by 8' to 12' in the period 1928-45. The average annual rise varied between .02' to 1.29'. In future, the rise might be even more rapid and a situation similar to that in the adjacent State of Punjab might develop.

5.2. Increase in the incidence of malaria is associated with accentuating water logging conditions. This disease is prevalent in the colony in certain areas especially after the rains, although it has not as yet assumed any serious proportions. An important public health benefit of irrigation is the provision of drinking water. Prior to the canal, people had to drink the brackish and impure water and even now it is not uncommon for human beings and cattle to use the same water from 'diggies' and 'johars'. The state of maintenance of these ponds is deplorable and water pollution has assumed a serious problem in the area. With the provision of fairly good drinking water facilities, the incidence of water-borne diseases such as 'Naharwa' (Guinae-Worm) is on the decline.

Limitations of data

6.0. In a study of this kind involving collection of data by direct field investigation the element of response is very important. Reliability of the data was tested by a number of simple checks and cross references made at various stages of the inquiry and a fairly close scrutiny of the various schedules and spot studies. The enquiry aroused special interest among the local farmers in particular those with medium or small holdings. However, apprehensions and misgivings regarding the impending land reform measures in the State were uppermost in the minds of farmers, particularly those with larger assets and it is likely that this has introduced in the results an element of underestimation of output and farm assets. In a separate note appended to this report, the extent of statistical precision has been indicated.

6.1. It has already been mentioned that the year of inquiry was somewhat exceptional. Generalisations on the basis of a single set of observations, therefore, are subject to certain limitations. Nevertheless, the results of the inquiry provide a fairly clear and correct picture of the role of irrigation and the economic benefits of the canal. There will always be room for refinements in analysis.

6.2 In an analysis involving the concept of 'control' sample, the choice of comparable units is not always easy. In this study in respect of rural enquiries, the units were more or less comparable but the 'control' centre in urban enquiries was not exactly comparable, being itself under the influence of irrigation. In the ultimate analysis, no two regions are exactly identical. In the case of new projects, bench mark studies followed by periodic evaluation might yield a more precise measure of the effects of irrigation.

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APPENDIX I

NOTE ON SAMPLING DESIGN AND SAMPLING ERROR

A three stage sampling procedure was followed in the present study. As earlier indicated in Chapter III, a total culturable commanded area of 5.3 lakh acres formed the universe of study. At the first stage, the area was divided into the major perennial and non-perennial zones. For each of the zones separate lists of distributaries and minor channels were prepared. In the perennial zone there were 21 distributaries and 30 minor channels while in the non-perennial zones there were 10 distributaries and 5 minor channels. A random sample of channels was drawn from the perennial channels with 10 per cent sampling proportion and from the non-perennial channels with 20 per cent sampling proportion giving in all a sample of 8 channels that is, about 12 per cent of number in the universe.

At the second stage sampling, the following formula was used to estimate the sample chaks from each stratum or group of channels selected :

$$N = \sum_{i=1}^{P} \frac{P}{Pi} \times \frac{Ni}{nij} \sum_{K=1}^{n} \frac{Hijk}{hijk} \sum_{l=1}^{h} nijkl$$

[Estimate of Chaks]

Where P = Area in each stratum
Pi = Area commanded by the particular that is ith channel.
Ni = Number of chaks on the ith channel
nij = jth chak on the ith channel in the sample
Hijk = kth household in the jth sample chak in ith sample channel
hijk = kth sample in the jth sample chak in ith sample channel

With probability proportional to size, the size being the area commanded, formula (A) gave the following number of chaks to be studied on the respective channels.

Stratum Area (Acres)	Sample Channel	Area (Acres) Commanded	Total No. of chaks	Selected chaks	Chaks studied
	2	3	4	5	6
266664	B.B. Padampur	28022	37	15	15
	G.B. Karanji	30614	44	16	15
	G.B. Bijiynagar	13360	21	8	7
180767	'a' Thakranmali	7359	12	9	8
	'h' Kosulpur	5682	8	8	6
63445	L.N.P.2	3097	5	4	2
	L.N.P.5	2779	5	5	1
21685	Bhompura 38 N.P.	3492	9	1	1
532561	Total	94,405	141	66	55

The number of chaks actually studied was less than the sample as at the stage of enumeration it was found that some of the villages were depopulated. At the third stage sampling, 1/6th of the households in the selected chaks was sampled out randomly for intensive studies. In the case of those villages under the perennial minor channels, however, about 1/3rd of the households were take in the sample

Sampling error

Sampling error for gross produce on an irrigated area comes to about 4.175 per cent at 5 per cent level of confidence. For the unirrigated area, at the same level of confidence, the sampling error is about 24.6 per cent. This does not reflect so much the inadequacy of the sample (which was more than 30 per cent of the control area) as the wide variations in crop yields.

Other statistical parameters are also quite significant. The Arithmetic Mean of gross produce for irrigated area is 182.80 whereas it is just 61.39 for the non-irrigated. Standard Deviation and standard Error are respectively 38.37 and 3.984 for irrigated area and 30.28 and 7.70 for non-irrigated area. Quite significant conclusions can be drawn out of these.

Response estimate

Taking into consideration the attitude of respondent indifferent or cooperative, response has been estimated on an average to the extent of 83.7 per cent with a Sampling Error of 9.86 per cent at 5 per cent level of significance.

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APPENDIX II

DEFINITIONS, PRINCIPLES OF EVALUATION AND ALLOCATION OF ITEMS OF COST

A. CONNOTATION OF TERMS USED

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(d) *Exchange labour.*—It is treated like family labour and has been evaluated in the same way.

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3. *Labour used in maintenance of Farm animals.*—Labour spent on the upkeep of farm livestock have been imputed on the assumption that a whole-time adult worker can look after ten heads of cattle. The labour days so calculated have been added to the family labour days or to the work days of annual farm servants, if employed.

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(i) Rent paid in cash or kind to the landlord either as fixed cash amount or as batai rent in kind has been taken into account. In case of kind rent, the actual share of produce given to landlord evaluated at harvest price has been taken into account. The net rent paid in the latter case would be less the Landlord's share of expenses of cultivation for example, land seed, manure.

(ii) Rental value of owned land is estimated for the land owned by the cultivator on the rates prevalent in the village for similar land.

7. *Rate of interest on owned capital.*—Interest has been calculated at 4 per cent on the value of fixed capital consisting of farm building exclusive of residential one used by the farmer and his family implements and machinery and livestock.

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1. *Livestock.*—Straight line method has been adopted for calculating depreciation of livestock. The rates of appreciation and depreciation have been worked out for each category of livestock on the basis of actual experience in the area as follows :—

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(b) *Camels.*—Appreciation during 1—5 years, constant between 5—7 years and depreciation on straight line at an average rate of 14 per cent between 7—15 years.

(c) *Cow.*—Appreciation during 1—3 years, constant between 3—5 and depreciation on straight line at an average rate of 14 per cent between 5—12 years.

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E. INPUT, OUTPUT, PROFIT AND LOSS

1. *Input or Gross Expenditure—Includes*

(i) Wages of hired labour paid in cash or kind or both.

(ii) Wages of farmer and his family members.

(iii) Value of seed, manure and other cash expenses both purchased and farm produced).

(iv) Rent paid and rental value of owned land.

(v) Depreciation on livestock and dead stock.

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2. *Output or Gross Income includes*

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(ii) Value of the produce used in the house-hold or held over for the use of family.
(iii) Value of seed kept for sowing.
(iv) Value of the produce given over to others as wages or customary charges etc.
(v) Value of the by-products for example, straw and chaff carried over to next year as feed for cattle.

3. *Net Profit*, is the difference between output and input. This is synonymous to net income on basis 'A'.

4. *Family labour Income*—includes net profit or loss plus the imputed wages for the labour of farmer and his family. In other words it is what the farmer and his family receive for management, risk and their physical labour.

5. *Farm Business Income*—is the measure of earnings of the farmer and his family for management risk, their labour and capital investment. It is obtained by adding to the family labour income, the unpaid interest on owned capital and unpaid rent on owned land. This is synonymous to net income on basis 'B'.

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data was tested by a number of simple checks and cross references made at various stages of the inquiry and a fairly close scrutiny of the various schedules and spot studies. The enquiry aroused special interest among the local farmers in particular those with medium or small holdings. However, apprehensions and misgivings regarding the impending land reform measures in the State were uppermost in the minds of farmers, particularly those with larger assets and it is likely that this has introduced in the results an element of underestimation of output and farm assets. In a separate note appended to this report, the extent of statistical precision has been indicated.

6.1. It has already been mentioned that the year of inquiry was somewhat exceptional. Generalisations on the basis of a single set of observations, therefore, are subject to certain limitations. Nevertheless, the results of the inquiry provide a fairly clear and correct picture of the role of irrigation and the economic benefits of the canal. There will always be room for refinements in analysis.

6.2 In an analysis involving the concept of 'control' sample, the choice of comparable units is not always easy. In this study in respect of rural enquiries, the units were more or less comparable but the 'control' centre in urban enquiries was not exactly comparable, being itself under the influence of irrigation. In the ultimate analysis, no two regions are exactly identical. In the case of new projects, bench mark studies followed by periodic evaluation might yield a more precise measure of the effects of irrigation.

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APPENDIX I

NOTE ON SAMPLING DESIGN AND SAMPLING ERROR

A three stage sampling procedure was followed in the present study. As earlier indicated in Chapter III, a total culturable commanded area of 5.3 lakh acres formed the universe of study. At the first stage, the area was divided into the major perennial and non-perennial zones. For each of the zones separate lists of distributaries and minor channels were prepared. In the perennial zone there were 21 distributaries and 30 minor channels while in the non-perennial zones there were 10 distributaries and 5 minor channels. A random sample of channels was drawn from the perennial channels with 10 per cent sampling proportion and from the non-perennial channels with 20 per cent sampling proportion giving in all a sample of 8 channels that is, about 12 per cent of number in the universe.

At the second stage sampling, the following formula was used to estimate the sample chaks from each stratum or group of channels selected :

$$N = \sum_{i=1}^{P} \frac{P}{Pi} \times \frac{Ni}{nij} \sum_{K=1}^{n} \frac{Hijk}{hijk} \sum_{l=1}^{h} nijkl$$

[Estimate of Chaks]

Where P = Area in each stratum
Pi = Area commanded by the particular that is ith channel.
Ni = Number of chaks on the ith channel
nij = jth chak on the ith channel in the sample
Hijk = kth household in the jth sample chak in ith sample channel
hijk = kth sample in the jth sample chak in ith sample channel

With probability proportional to size, the size being the area commanded, formula (A) gave the following number of chaks to be studied on the respective channels.

Stratum Area (Acres)	Sample Channel	Area (Acres) Commanded	Total No. of chaks	Selected chaks	Chaks studied
	2	3	4	5	6
266664	B.B. Padampur	28022	37	15	15
	G.B. Karanji	30614	44	16	15
	G.B. Bijiynagar	13360	21	8	7
180767	'a' Thakranmali	7359	12	9	8
	'h' Kosulpur	5682	8	8	6
63445	L.N.P.2	3097	5	4	2
	L.N.P.5	2779	5	5	1
21685	Bhompura 38 N.P.	3492	9	1	1
532561	Total	94,405	141	66	55

The number of chaks actually studied was less than the sample as at the stage of enumeration it was found that some of the villages were depopulated. At the third stage sampling, 1/6th of the households in the selected chaks was sampled out randomly for intensive studies. In the case of those villages under the perennial minor channels, however, about 1/3rd of the households were take in the sample

Sampling error

Sampling error for gross produce on an irrigated area comes to about 4.175 per cent at 5 per cent level of confidence. For the unirrigated area, at the same level of confidence, the sampling error is about 24.6 per cent. This does not reflect so much the inadequacy of the sample (which was more than 30 per cent of the control area) as the wide variations in crop yields.

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